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Electronics AUSTRALIA WITH ETI

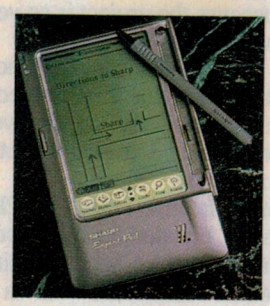
Volume 55, No.10
October 1993

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

Photo CD update

Kodak's system for saving up to 100 high quality photo images in digital form on a compact disc is now available in Australia, and looks set to make a big impact — with print media publishers in particular. Barrie Smith provides an update on Photo CD in our feature story beginning on page 8.

Sharp's own PDA model



It's well known that Sharp Corporation is making Apple Computer's new 'Newton' Personal Digital Assistant, in Japan. Now the company has also released its own version, the PI-7000 Expert Pad. See our news story on page 101...

On the cover

Our model this month is EA's own Karla Dixon, who volunteered to show how easy it is to assemble our new 'learn while you build it' AM/FM portable radio project. The first of two articles describing this project starts on page 34. (Photo by Kevin Ling)

Video and Audio

Features

Projects and Technical

Professional Electronics

Columns and Comments

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HEAD OFFICE - EDITORIAL
180 Bourke Road, Alexandria, NSW 2015
P.O. Box 199, Alexandria 2015
Fax number: (02) 353 0613
Reader Services: Phone (02) 353 0620
Subscriptions enquiries: phone (02) 353 9944
Book Shop enquiries: phone (02) 353 9944
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ELECTRONICS AUSTRALIA is published by Federal Publishing Company a division of Eastern Suburbs Newspapers Partnership, which is owned by General Newspapers Pty Ltd.
A.C.N. 000 117 322
Double Bay Newspapers Pty Ltd.
A.C.N. 000 237 598
and Brehmer Fairfax Pty Ltd.
A.C.N. 008 629 767
180 Bourke Road, Alexandria, NSW 2015.

Printed by Macquarie Print, 51 - 59 Wheelers Lane, Dubbo NSW, 2830, phone (068) 843 444, for Federal Publishing Company.
Distributed by Newsagents Direct Distribution Pty Ltd, 150 Bourke Road, Alexandria, NSW 2015. (02) 353 9911.
The Australian Publication emblem on the front cover of this magazine is there to proudly signify that the editorial content in this publication is largely produced and edited in Australia, and that most of the advertisements herein are the products and services available within Australia.
ISSN 1036-0212
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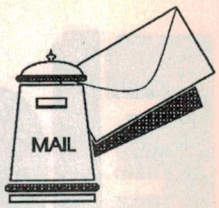
LETTERS TO THE EDITOR



Exhaust analyser

Could you give consideration to a project for measuring the CO_2 content of car exhausts?

I know there is a kit for detection of CO_2 inside a car, but to my knowledge, none to measure that coming out of the exhaust system.

In these times, when the environment is so important, it would be very beneficial to be able to check and adjust, when necessary, the CO_2 content of our car exhaust systems.

G.H. Pell,
Clayton North, Vic.

Comment: We'll look into it, Mr Pell. The hardest part is likely to be finding a suitable sensor.

Real time clocks

Regarding the release from DCS appearing on page 110 of your July issue, I would like to point out that Motorola has not discontinued the MC146818 or MC146818A Real Time Clocks in DIP or SMD packages. What they have discontinued are the module versions, whose part numbers were MCCS146818 and MCCS146818B1M.

Ted Clinton,
Veltek,
Burwood, Vic.

2UE antenna

With regard to Neville Williams' article 'Murray Stevenson - 2', in July 1993, on page 41, there was discussion of the 200ft tapered self-supporting tower erected in 1939. The final paragraph in this discussion suggests that this tower was dismantled when it was 'replaced by a taller one of uniform cross section'.

It may interest your readers that the 1939 tower is still standing (adjacent to new Concord Road Bypass, in Homebush Bay) and is currently being used by Radio for the Print Handicapped (2RPH), until they move in a few months to the original 2WS transmitter site in Prospect.

It would be interesting to know what the Government plans to do with the 1939 2UE transmitter site once 2RPH vacates. It would be a shame to have this piece of history destroyed.

The mast which was built to replace this tower was dropped late last year, to make way for the construction of the new Olympic facility. 2UE now shares the 2SM facility in Homebush Bay.

Keep up the good work,
Ron Langhans,
Sydney Branch, HRSA.

Digital recorder

I have recently completed the Digital Voice Recorder from the November 1992 edition of your magazine, taking a chance on my ability to handle, soldering in place, the surface mount chip by purchasing the expanded version (DVR #11) with the extra three 1Mb chips.

After a full weekend of patient trial and error under the magnifying glass, the recorder performed as no other digital project possibly could. I mean, this little unit is nothing short of brilliant, in its operation and possible uses.

Congratulations, to your design contributors, and your magazine for presenting such a useful project. The construction complexity of the expanded model is very definitely worth the extra work it takes, to solder in place the speech chip.

Now, because the project is so versatile, I will wait in anticipation for further designs. Designs that can interface with the DVR #11 project to take electronics another step forward into the world of computer-controlled voice instructions or digital recorded music (the sound reproduction is first class, at 32k). Are any 'add-ons' planned for future projects?

Imagine the effect such a unit could cause, when connected via a touch switch, to the metal body of the car you were admiring, in the second hand car yard.

A pleasant voice talks on the features of the vehicle, tells the past history, discusses other details — hey, this gadget might replace the used car salesman! At least they could program the truth about the vehicle into the recorder, so as to be sure to stick to the same story on every telling.

A self contained unit could be built with battery power, solar charged, with a light dependent resistor to switch it off at night. This design could be very useful if connected to a miniature FM transmitter, such as the Ant or Amoeba, which the same designer, Colin Mitchell featured in his books. Such a circuit design would allow the unit to transmit a recorded sales

message to a car radio, for example, when shopping for houses.

As long as the transmitted power was kept to about 10 metres maximum, it would not interfere with anybody and the unit could be locked to a position in the front of the property, sending out its message all day long on the features of the house.

The transmitter could be tuned to a vacant spot on the FM band, with its transmitting frequency displayed on the Real Estate Agent's board, or auction board as Colin Mitchell called it in his article. What a great idea for home hunters — pull up outside the house and listen through the car radio to a description of the property.

Keep projects like this coming and you will always attract new readers to your magazine and the expanding world of electronics, and further the possibilities for advances in other designs. Once again, thanks.

One minor inquiry. What is the purpose of the 10nF greencap across the 10k trim pot? On the parts list of the DVR #11, this capacitor has been left out, also in the kit the greencap is missing. I raided a 10nF from the continuity tester (TE) and placed it in circuit in the DVR #11. It does not seem to make any difference to the operation of the circuit. Is this capacitor needed?

Jack Gill,
West Moonah, WA.

Comment: Glad you liked the project, Jack. The 10nF capacitor is to smooth the digitised audio from the chip, so it has as little digital 'hash' as possible. It should be fitted, even though you may not be able to hear much difference. It was shown in our parts list; we can't explain why it doesn't appear in the kit or its parts list — you'll have to ask Colin.

Call for help

I would like to know if anyone has reviewed Acoustat No.4 loudspeakers, as I have just bought a pair second hand. Also, would anyone have a circuit for a Cybernet 200 tuner amp.

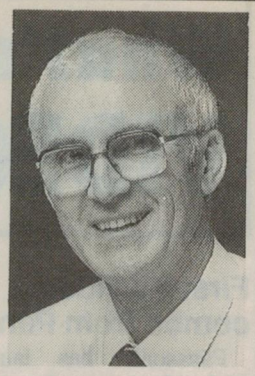
You publish a good and interesting magazine.

E.L. Scharenguivel,
12 Sutherland Way,
Cloverdale, WA 6105

DROP US A LINE!

Feel free to send us a letter to the Editor. If it's clearly expressed and on a topic of interest, chances are we'll publish it — but we reserve the right to edit those that are over long or potentially libellous.

EDITORIAL VIEWPOINT



Learning electronics while you build something useful

For many years, one of the most popular (and effective) ways to get yourself a good 'hands on' start in electronics was to build a radio receiver and get it going. I remember getting started this way myself, back in 1951, when this very magazine (then known as *Radio and Hobbies*) ran a series of articles called 'Learn While You Build'. This began with a simple diode detector, and showed you how to enhance it in stages right up to a full mantel-type superhet. My father bought the parts month by month, and we worked through the articles as they came out — both of us learning quite a bit, in the process. Dad lost interest after that, but it was enough to get *me* launched on a lifetime career!

I'm sure many other people of my generation got going in electronics in much the same way. A radio receiver makes a good project with which to learn the basics of electronics, because it's not too complex and relatively easy to get going. At the same time it involves enough technology to be interesting, and also ends up as something with a practical day-to-day use.

Unfortunately it hasn't been easy for young people and other newcomers to get going the same way in recent years, because many of the parts needed for an easy-to-build radio project have been relatively hard to get. Like many other aspects of electronics, radio receivers have also been impacted by the IC revolution, and all of their active circuitry is now typically compressed into a single chip. This is great for economy, reliability and compactness, but not entirely suitable for either understanding the basics or building a project in stages!

Despite these complications, there's no doubt that there is still a definite ongoing need for a 'learn while you build' radio project — even if it does have to use an all-in-one IC chip. In fact there's even a case *in favour* of basing a project on such chip, because virtually all commercial models now use them and it's a good idea to become familiar with this technology right from the start.

Aware of this need, the people at Dick Smith Electronics have been searching for a suitable 'knocked down' radio kit for some time. And a couple of months ago they finally found one — which goes together to make a very presentable AM/FM portable.

Would *EA* be interested, they asked, in telling our readers how to put the radio together from the kit, and learn some of the basic concepts of electronics in the process? Indeed we were, and that's the story behind this month's cover picture and the story which starts on page 34.

Mind you, it was only when I set about writing the article for the project that it finally dawned on me what a challenge it presented. By the time I had given a preamble, introduced the concepts of a superhet receiver, explained what's in the Sony chip which forms the heart of the project and then described the schematic, the article had already grown so large that it was obvious the rest would have to wait until next month!

All in all, though, I'm very grateful to DSE for having found this kit and making it possible for us to present an up-to-date version of the old 'Learn While You Build' projects. I'm hopeful too that it will help many of today's youngsters get *their* start in electronics, just as I did back in 1951.

Jim Rowe

karaoke and 'intelligent' features found on the company's flagship models.

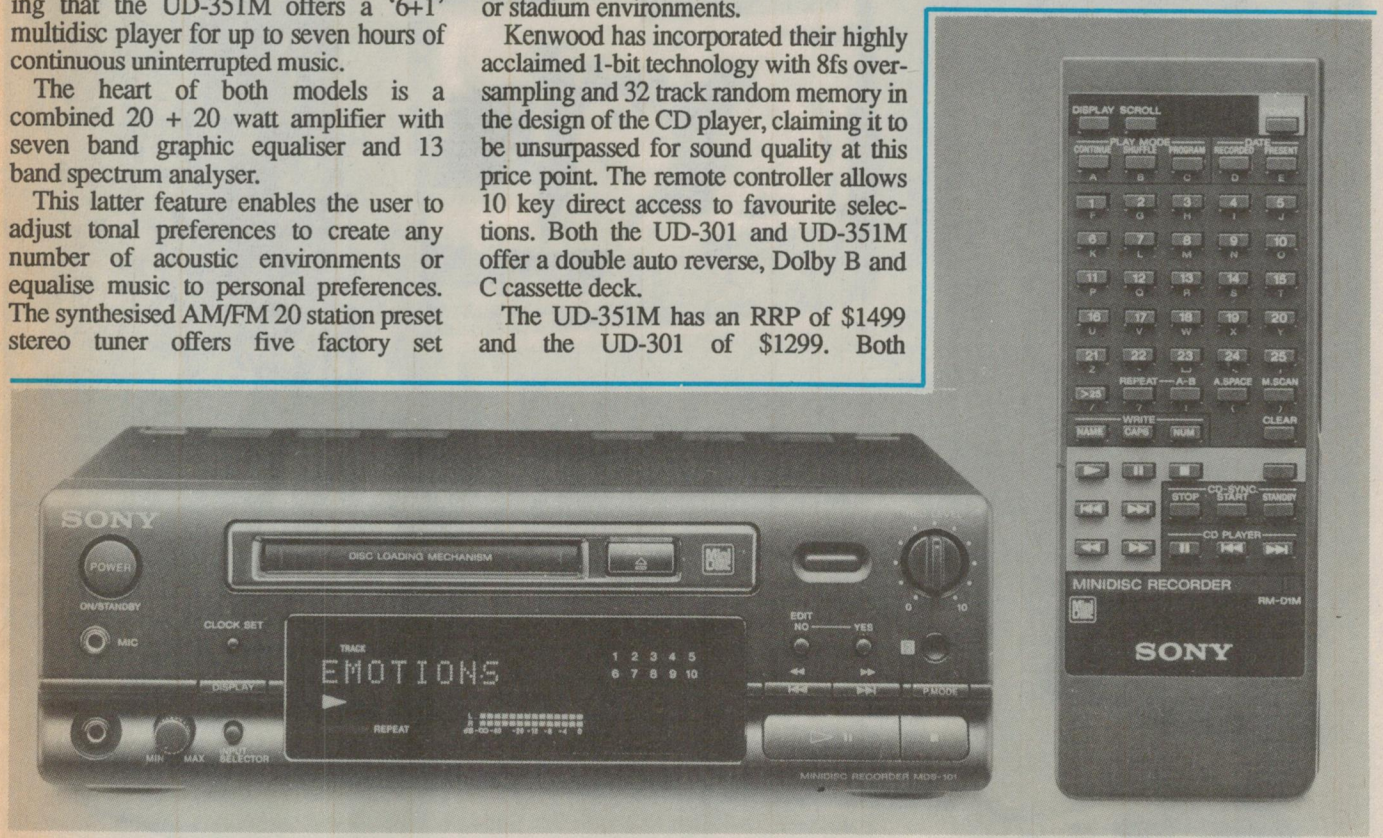
The specifications of both the UD-351M and UD-301 are identical excepting that the UD-351M offers a '6+1' multidisc player for up to seven hours of continuous uninterrupted music.

The heart of both models is a combined 20 + 20 watt amplifier with seven band graphic equaliser and 13 band spectrum analyser.

This latter feature enables the user to adjust tonal preferences to create any number of acoustic environments or equalise music to personal preferences. The synthesised AM/FM 20 station preset stereo tuner offers five factory set memory settings plus an additional five user memories. Both models incorporate Kenwood's 'presence' modes which offer a choice of arena, jazz club, or stadium environments.

Kenwood has incorporated their highly acclaimed 1-bit technology with 8fs oversampling and 32 track random memory in the design of the CD player, claiming it to be unsurpassed for sound quality at this price point. The remote controller allows 10 key direct access to favourite selections. Both the UD-301 and UD-351M offer a double auto reverse, Dolby B and C cassette deck.

The UD-351M has an RRP of $1499 and the UD-301 of $1299. Both models are covered by a three year parts and labour warranty (12 months labour) and are available at selected Kenwood dealers.



Sony releases home, professional MD decks

As we reported last month, Sony has finally launched its Mini Disc system in Australia. In addition to the portable MZ-1 recorder reviewed by Louis Challis in that issue, the company has also released an MD player/AM-FM radio combination for cars (MDXU1), a component MD record/play deck for domestic stereo systems (MDS101) and both an MD 'Cart' recorder and player (PMD-C1 and PMD-C1P) for the professional broadcasting market.

The MDXU1 car MD player is an in-dash unit featuring an easy to read backlit 12-character dot matrix LCD screen, which displays title, track name and time information. Like the portable, the player has an inbuilt four-megabit DRAM memory buffer to ensure continuous playback even if the laser pick-up skips tracks due to jarring. The MDXU1 also connects to other components of a car audio system, via the Sony UniLink system.

The anticipated RRP for the MDXU1 is $1999, and it should be available from car stereo specialists by the time this issue is published. The new MDS101 domestic MD record/play deck is expected to be available in department stores and specialty outlets at the same time, with an RRP of $1799. This unit can record on blank magneto-optical MD discs, as well as play back both these discs and pre-recorded MDs. It features what is described as a comprehensive array of editing capabilities, including the ability to search for and make use of free space on a partially recorded disc. A 'date stamp' function stores on disc the date and time that a recording was made, while a 'title' function allows the user to add names and track titles of up to 100 characters (1700 total per disc).

The MDS101 measures 225 x 75 x 285mm, weighs 2.9kg and has a power drain of 25W. It has a rated frequency response of 5Hz - 20kHz +/-0.5dB, and a signal-to-noise ratio of more than 96dB during playback.

The PMD-C1P professional MD cart player allows any track to be cued by number, while a memory start function provides instant audio playback. A random music sensor (RMS) function allows tracks to be programmed in any order. Both single and continuous playback modes are possible, and an EOM (end of message) signal can be programmed prior to completion of a program and this signal can be used as a tally. The PMD-C1 features a 12 character fluorescent display for high visibility, balanced audio outputs, and a parallel remote port for external machine control.

The PCD-C1 recorder duplicates all functions of the PMD-C1P, while adding the capability of recording up to 74 minutes of stereo on a blank MD. Like the consumer MD recorder, it also uses the TOC (table of contents) data area for editing functions and comes with a remote control.

The PMD-CI and PMD-C1P are expected to be available in Australia by the end of the year. No prices have been quoted as yet. Sony claims that its recordable MiniDiscs can be re-recorded over a million times without degradation in sound quality. At 64mm in diameter and in a dust-resistant cartridge measuring only 68 x 72 x 4.5mm, they are only 1/3 the size of an audio cassette.

Available in two recording times of 60 and 74 minutes, designated MDW60 and MDW74 respectively, the blank MDs should also be available in retail, music and department stores by the time this issue is published. Estimated RRP's are $19.95 and $23.95 respectively. ❖

PHOTO CD NOW HERE IN AUSTRALIA

It's taken a couple of years since the technology was first announced, but this exciting joint development by Eastman Kodak and Philips is now a practical reality in the Australian photographic and publishing markets. Here's an update on what has happened since our last look at Photo CD.

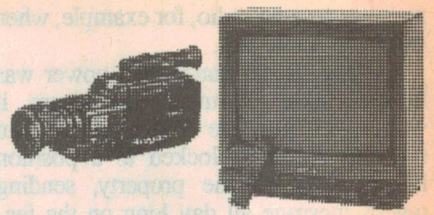
by BARRIE SMITH

At its first showing in Sydney in 1991, it was obvious even then that Photo CD was going to be a monumental development in the 160 year old technology of photography — bringing with it the ability to digitise silver-based colour images. This digital data could be processed on a computer, with any level of picture manipulation desired, and final output delivered with quality comparable to a photographic print or transparency. The whole process of using photographs would then undergo a major switch — shoving aside enlargers and associated print materials and chemistry, plus — in the area of print reproduction — allowing PCs to produce colour separations on the desktop.

In other words, Photo CD signalled a brave new *digital* photographic world.

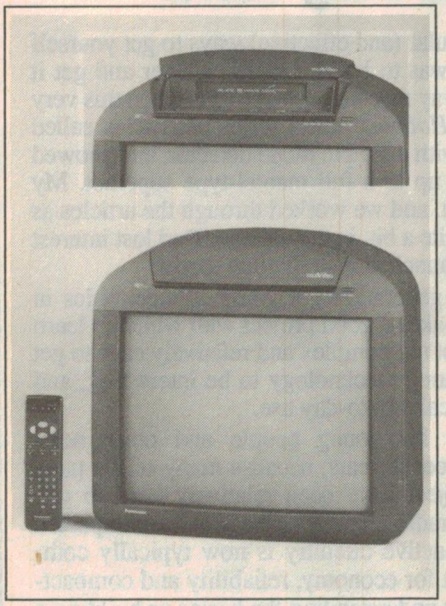
At the 1991 launch the trumpets were directed at the consumer 'happy snapper' brigade, and at its commercial 'roll out' in May this year, comparable emphasis was still on the consumer market. But a paper delivered at the Sydney 1992 SMPTE Convention had revealed that Photo CD

What's New in VIDEO and AUDIO



First TV/video combo from Panasonic

Panasonic has launched its first 'Televideo' onto the Australian market. The company says that the Televideo combines in one stylish unit 'the best of Panasonic mid-screen television technology' with its high quality, four head video format. The compact, portable entertainment system is known as model TC-W21, and has a VHS video deck located above a 51cm screen TV. Designed for homes, offices, institutions and retail stores, it needs only two connections for operation: the power and an aerial.



Features include audio/video in/out terminals for hooking the TV to other equipment, a sleep timer and on-screen indicators. For easy operation, the video deck starts playing as soon as a tape is loaded and recording is a simple, one button operation on the remote control.

The World 7 system compatibility on the Televideo means it can record and playback in both PAL and NTSC.

Recommended retail price is $2599.

Kit removes CD scratches

Harald Schmid, an inventor in Ludwigsburg, Germany, has invented a kit that allows scratches to be removed from compact discs by grinding down an area of the plastic disc with a specially designed sandpaper.

Despite optimistic claims that compact discs never wear out like vinyl plastic records, scratches on a CD can interfere with the process of reading the recorded data. The result is that the CD player can mistrack, mute or skip.

Several companies have begun marketing disk repair kits that usually include polishing and cleaning materials. Mr Schmid's kit goes a step further by including several grades of sandpaper and guidelines for removing even fairly deep scratches.

Trackmate Australia is distributing the CD repair kit in Australia. Suggested retail price is $29.95 and the kit is available at all Tandy stores and quality hifi outlets.

'Entry level' mini stereo from Kenwood

Kenwood describes its new UD-351M/301 mini series as 'an embodiment of functional harmony' which is claimed to incorporate many of the presence,

Compact speaker system from Dali

Modern trends are for loudspeakers with a narrow 'footprint', a relatively slim enclosure and unobtrusive visual design; all these features were design objectives in developing the Dali 3A Mk 2 loudspeaker.

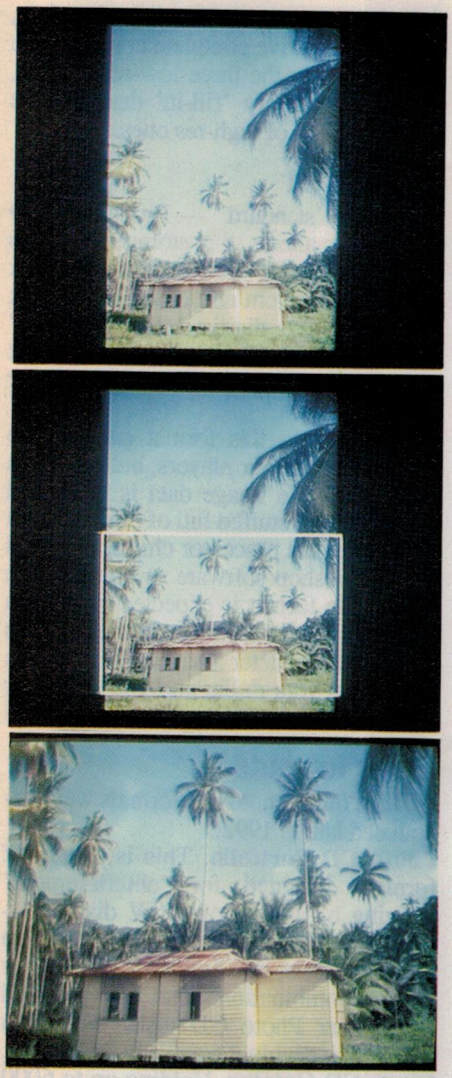
The system uses two 170mm Vifa polypropylene bass/midrange drivers with long linear travel, durable rubber suspension surrounds, and soft rubber dustcaps. The use of two relatively small drivers gives high sensitivity (92dB for one watt at one metre) with high power handling; amplifiers up to 100 watts RMS are recommended.

The tweeter chosen for the speaker is a new Vifa design using soft textile as the dome material. This material is particularly well damped and has excellent transient characteristics. The use of ferrofluid cooling gives high power handling and general durability.

As with all Dali speakers, the crossover network is of the linear directivity type, ensuring good sound distribution within the listening room and enabling several listeners at once to receive a smooth frequency response.

The front baffle of the Dali 3A Mk2 is covered in 'Acousti-Flock' absorbent material, in order to reduce edge diffraction and improve stereo imaging.

Further details are available by circling 181 on the reader service card or contacting Scan Audio, 52 Crown Street, Richmond 3121; phone (03) 429 2199, fax (03) 429 9309.



These three TV screen shots show how the Photo CD player allows a vertical format image to be cropped back to horizontal format and enlarged. At top is the original vertical image; the centre shot shows it with the cropping frame positioned and at bottom is the resulting 2X enlargement.

would be able to encompass the resolution levels of 4" x 5" transparencies — 13 times larger than the common or garden variety 35mm trannie. So the technology obviously has applications far wider than consumer snaps.

It is only now that a full description of the process and its potential can be given.

Consumer level

An exposed roll of 35mm neg or transparency film is handed in to a photo lab. Along with the order for the usual mini prints, a CD is also specified. The film, after processing and printing is sent to a Photo CD workstation. The frames are digitised and 'written' as Photo CD files onto 12cm CDs, near-identical to the ubiquitous audio platters.

This picture of Kuala Trengganu hotel pool and the South China Sea was originally shot on 35mm Kodachrome and then transferred to Photo CD. The data was then imported to Kodak's new PhotoEdge software, and a second-level 'sharpen' filter applied (more an 'effect' than a legitimate device to increase sharpness). The resulting Macintosh TIFF file of 4.5MB was then given to Slideworks in Sydney, who used their Solitaire film recorder to produce an 8000-line 35mm transparency. Note how the image quality has been retained.

Having collected prints and CD, the customer then hotfoots it home. Once home, the customer turns on his newly-acquired player, inserts the disk and plays the family snapshots on the TV. So the TV replaces your old 35mm slide projector and screen. On this 'bread and butter' version of the Photo CD, the individual 35mm images are each stored in five levels of resolution — described as:

Level 1: 'Base over 16' resolution or 128 x 192 pixels. This level is suitable for 'thumbnails', contact proof sheets or to create 'picture in picture' effects on a TV display.

Level 2: 'Base over four' resolution or 256 x 384 pixels. This level provides roughly one fourth of TV quality — suitable for small prints.

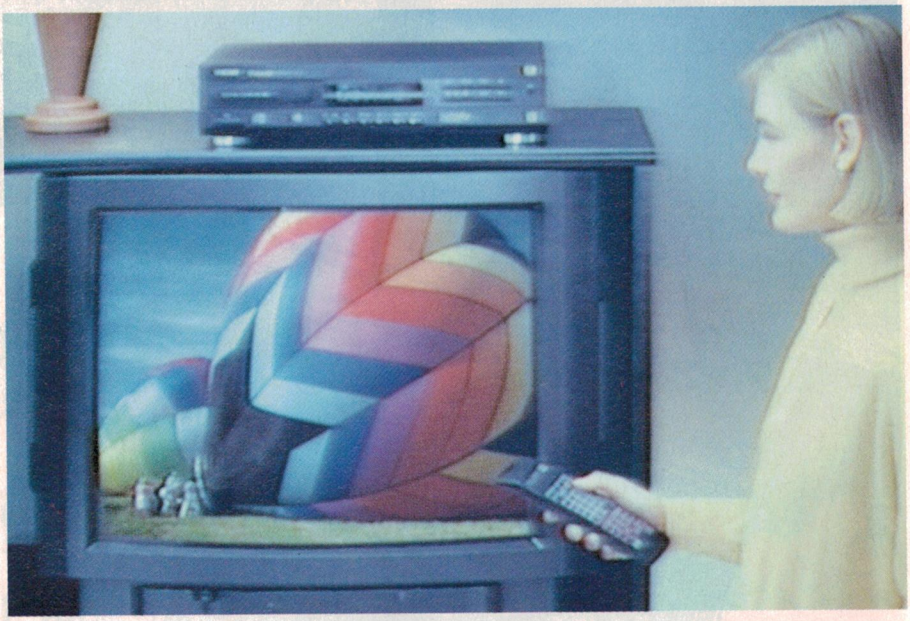
Level 3: 'Base' resolution or 512 x 768 pixels, and designed for viewing on TV sets. This is the level accessed by the standard player.

Level 4: '4x Base' resolution, or 1024 x 1536 pixels. This is equivalent to HDTV.

Level 5: '16x Base' resolution or 2048 x

Photo CD now here in Australia

These further screen photos show how the TELE button can be used by itself, for zoomed images. On the left is a picture of the Malaysian town of Malacca, with the cropping frame positioned to indicate the area to be enlarged; on the right is the resulting enlarged view.



Kodak has big hopes for Photo CD in the consumer area, but its initial impact may be higher in the professional photography and publishing markets.

The rear panel of Kodak's PCD 865 player provides a modulated RF output, a SCART connector, an S-VHS video socket plus RCA sockets for composite video and stereo audio.

3072 pixels. This level effectively captures all of the information in a 35mm frame.

Kodak have pulled a neat trick to pack the disk's 600MB (megabytes) of storage capacity with image data: the first three levels of resolution are committed to disk without data compression. To view an image at Level 4 (4x Base), additional information is added to Level 3 to produce the higher quality image. Level 5 (16x Base) adds still more data to reach the resolution level of the original 35mm trannie. All of this additional data is compressed. The disk, therefore, does not hold five complete copies of the image — only the three low-res images, plus the necessary 'fill-in' data for the remaining pair of high-res ones.

Pro format

Another 'standard' — Pro Photo CD Master — allows the storage of more data from larger film formats (6cm x 4.5cm, 6cm x 9cm and others up to 4" x 5"). These are digitised at '64x Base' resolution, with 12-bit sampling (4096 x 6114 pixels), resulting in 24-bit colour image files.

The disks in this format can still be 'read' by consumer players, but of course excel when the image data is processed by a computer stuffed full of RAM, a high speed graphics processor chip and loaded with Photoshop software or similar. The Master file format is expected to contain copyright and security barriers, plus encryption to deter unauthorised access ('you pays your dollar and you gets your access code').

Other formats

Three other Photo CD formats were announced late in 1992:

Photo CD Portfolio. This is a one-off format, designed for 'entertainment' viewing of images on a TV display — using the Base resolution. Capacity is up to 800 images, one hour of audio or any desired combination. Data is transferred from other Photo CD disks, not from scanned, individual frames.

Photo CD Catalog. Holding up to 6000 images, this is a mass-produced 'catalogue on disk' using a lower resolution. The disk will have the facility for key-word searching and branching. Versions in DOS, Windows and Macintosh will co-exist.

Photo CD Medical. Aside from being able to store images from various imaging sources — including digital images from ultrasonic scans, etc., — this will be the only Kodak format able to encode digital data.

Behind the scenes

There are three Photo CD Imaging Workstations (PIW) currently running. The first established was in Perth about 12 months ago, with the second set up in Coburg, Melbourne. The third is in Sydney, in the suburb of Waterloo.

All three are operated by Kodak Photo Services. By the time this magazine is published there will be a fourth, privately owned and operated as a bureau service by David Myers and Associates in North Sydney.

Mike Coles, Electronic Imaging

Malaysia online

For this writer, the month prior to the official roll out of Photo CD was an eventful one. First, the Kodak company offered to make a CD of 100 of my images.

Having spent a considerable amount of my time in Malaysia over the years, I have acquired a formidable bank of stock shots in that approachable and fascinating country.

Second, I made the 'big decision' and retired a four year old Macintosh SE in favour of a hot, new Centris machine with all the RAM and processing power a 1990's operator needs. The Centris also housed a CD-ROM player — capable of replaying Photo CD files.

The golden picture platter, crammed with 100 images of temples, palms and other Asian exotica, arrived within days of the arrival of my Centris. The moment of truth then followed soon after: I found that, no matter how much I manipulated memory, I could not open the top two levels of resolution on the disk.

It should be noted that a Photo CD disk can be read on a Mac or IBM-clone PC, or a CD-I player — or replayed to an NTSC or PAL television set. In seeking a CD-ROM player for Photo CD, one must choose a 'multi-session' model, capable of reading images committed to the platter in multiple recording sessions.

Product Manager for Kodak, offered some more technical detail on the scanning process — information which has not been revealed before now.

There are two scanners used in a PIW. One is the PCD2000, designed to handle 35mm transparencies and negatives — colour or mono; the other is the PCD4045 — able to handle film formats from 35mm, 120 (6cm x 6cm and 6cm x 9cm) and 5" x 4".

In use, the scanners are linked via a SCSI interface to a SUN SPARC2 workstation. This, after processing the image data, sends the digital information to the disk recorder itself.

The PCD4045 scans a 4000-pixel wide image in 6000 steps, passing the data onto the SUN computer at a rate of 3MB per second — thus creating a 6K x 4K scan. The scan of a 5" x 4" image takes 90 seconds to complete. However once accepted by the SUN, another three and a half minutes are needed for the data to be processed before it can be passed on to the CD writer.

In the writing process Huffman compression code is applied, resulting in a file size (on disk) of around 20MB. That file, when fully opened on the computer desktop, swells to about 72MB. About 20 - 30 images can be stored on the CD at Pro resolution.

File sizes can vary by around 15 - 20%, according to the degree of uniformity in the image detail; for example blue skies and areas of plain tone can undergo greater compression.

A 35mm trannie can also be scanned on the PCD4045 — so gaining a resolution advantage. The column of the scanner zooms to the right frame size, operating as a stepped zoom and allowing scans of 35mm, 120 or 5" x 4" to be made on the same hardware. The scanning time doesn't vary that much. Throughput is around twelve 35mm frames per hour at 6K x 4K high resolution.

The PCD2000 for 35mm scans provides 2K x 3K capture files and runs at about 120 frames an hour. Technically, 300 are possible, but reality indicates that about 120 is more practical.

In both scanners the CCD sensor is bar-shaped, being three pixels wide by 2000 pixels long (35mm version), or 4000 pixels long (4" x 5" version). In each case one row of pixels is used for each of the three colours.

In operation the film is pulled over the scanner once, scanning the red, green and blue colours simultaneously. With the 35mm scanner the film moves in 3000 steps, thus capturing 2000 x 3000 pixels for each colour. The PCD4045 scanner moves through 6000 steps, capturing 4000 x 6000 pixels for each colour.

Dyes under the gold...

The method of information storage in Photo CD disks differs from that of its cousins — CD-ROM and audio CD. Dyes akin to those used in colour photography are applied to the clear substrate, under a 24-carat gold layer. In the 'writing' process, a laser beam alter the dyes to produce a series of transparent pits. This is different from the creation of audio CD masters, where tiny pits are burnt into the surface.

Much of the actual processing is taken up by the colour management systems, to take into account the filtering necessary for differing emulsions — say Ektachrome compared with colour negs. This processing is done 'on the fly' in the scanner itself, allowing the scan to be passed onto the SUN as a high quality corrected scan. It is then converted to a YCC (luminance/chroma/-chroma) format.

Encryption

Three levels of encryption are available on Pro format Photo CD's. One is a standard copyright notice, giving information on the author and any reproduction restrictions. For the second level, the word PROOF is imprinted across the image, only unlockable by contacting the Photo CD producer and acquiring a key code.

For the third level one of the colour channels is locked, so the image is visually useless on the monitor. Again, acquisition of a key code is necessary to unlock the channel and so get access to the full colour and resolution of the image on the CD.

Kodak's PCD 865 player

Thanks to Kodak, I had an opportunity to use one of their single disk PCD 865 domestic Photo CD players for a short time. Its output was fed to a late model Mitsubishi 51cm TV set.

The PCD 865 Photo CD player is a simply, but elegantly styled unit similar in size and appearance to a VCR. The remote control has 40 buttons, grouped into three clusters. None — I repeat none — of the controls was dual function. The deck and remote were obviously Western in design logic!

You simply open the loading tray, pop in the CD (either Photo CD or audio) and the machine starts. If the disk is a Photo CD, a 'Welcome to Photo CD' graphic appears — just to let you know the deck is awake!

Should you load an audio CD, the usual timing and track information pops onto the LED panel. The Photo CD players have audio capability and use a one-bit D-to-A processor. For less than $600 you can show still images on your TV, and play a CD — unfortunately, not at the same time.

The audio mode has most of the functions of a standard CD player — both on

Costs: Player, processing, workstation

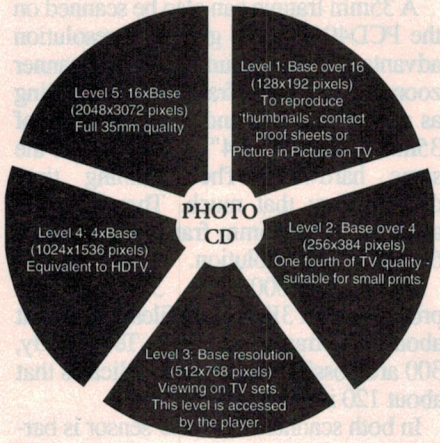
Two Photo CD players are currently on sale: the PCD 865, a single disk player, priced around $595, and the five-disk carousel model PCD 5865 which costs $695.

Photo CD Imaging Workstations (PIW) have been set up in Perth, Melbourne and Sydney by Kodak. By the time you read this, it is expected that at least one private installation will be in place in North Sydney to service the professional market. These cost 'over $200,000' each.

Concurrent with the Photo CD launch earlier this year, a special 'deal' was available, whereby 65 images from colour or monochrome negatives or slides could be transferred to a disk for $100. Normal service on a roll of 24 exposures is expected to cost $1.17 per image transfer to Photo CD — plus $12 for the disk. So the total would be just over $40. There will then be room for another 76 images on the same disk. Turnaround time is quoted at seven days.

What about prints? Hard copies of any digital image on a Photo CD can be made on thermal paper — for around $16 for an 8x10 print.

Photo CD now here in Australia



How the Photo CD pie is divided up in the consumer format: levels one to three are stored without data compression. Files in level one average around 128k; while level five files weigh in at around 4.5MB.

the remote and the main panel: fast search, shuffle tracks in random order, repeat, pause — there's even a Time Edit control to help you cram the maximum, unbroken, number of 'tidily-timed' CD tracks onto a cassette recorder. A function called FTS (Favourite Track Selection) enables a series of CD's and their play lists to be logged for future, customised listening.

Sound quality was on par with other consumer level CD machines. I encountered some background noise with the machine routed through a VCR's tuner, but once the R and L outputs were connected directly to my amplifier it produced a clean, noise-free signal.

But back to the video side. Of course, to connect the deck and route its signal to the TV set took the usual fumble and fiddle, searching for the deck's output signal, finally found on the 0 - 5 VHF band. Picture quality I would assess as being level with received broadcast TV.

The rear panel carries RF IN and OUT — so you can 'daisy-chain' other video devices; there is also an S-video output, a SCART connector for direct video out and audio RCA outputs.

I began with a practice and demo disk supplied with the player. Here, an immediate march over competitive technology is apparent. The information is displayed via on-screen menus and, aside from giving a choice of languages (narrative and graphic), allows either the full demo to be run or gives you access to various specific explanatory sectors. There are also 20-odd images to play with for the honing of your operational skills.

Trying it out

I was, frankly, surprised at the fast access time of the player. Pictures would change in less than a third of a second, and picture tricks took only a little longer.

Once displayed, you could modify each picture to an enlarged view (TELE), tilt and pan, and rotate the pic in 90° intervals.

SCAN mode displayed each image, reduced in size, for two seconds — letting you fly through a 100-image inventory in around five minutes. AUTOPLAY shows the same inventory, with each image shown at full screen size. Display time can be set at two, four or eight seconds.

I changed disks, inserting my 100-image 'reservoir'. This collection includes a mix of horizontal and vertical compositions — but there were no problems. I simply replayed each one and, when a vertical image popped on I pressed FRAME — this superimposed a white horizontal rectangle over the picture.

I could move this to provide a pleasing 'crop' of the image, then hitting TELE, moved into a 2X enlargement. This removed the unwanted side borders.

Next, I pressed KEEP. This committed the setting to memory and, at any time in the future, ensured my uncomfortable vertical picture would be comfortably 'horizontalised'.

Another control — SKIP — permitted a picture to be deleted from memory. Or more correctly, its address would be deleted. The picture actually remains intact on the disk. KEEP and SKIP are part of the FPS (Favourite Picture Selection) features, which make the Photo CD player such a 'user-considerate' device. FPS is a powerful feature; the handbook revealed nothing about the memory capacity — of image or disk settings — but I later learnt the settings memory is 8KB.

It was clear the memory was finite and that the 'FULL' sign would be displayed when the rafters had been reached.

At this point it is suggested the optimum method for clearing more 'space' is to delete a 'little used disk' from the player's memory. Should matters become even more drastic and the entire memory be in need of evacuation a Melbourne 008 number is provided in the handbook!

The player seemed to offer much, video-and audio-wise, in an attractively configured package. It is my own hope that Kodak can make a go of it in the consumer market. Photo CD deserves to win friends. ❖

New Dick Smith Electronics/EA Competition:

We have 10 of these Sangean World Band Receivers to be won by lucky EA readers!

Dick Smith Electronics has provided *Electronics Australia* with ten of the new Sangean ATS 606 compact PLL synthesised World Band Receivers, to be offered as a prize to our readers. So here's your chance to acquire one of these state of the art receivers — each worth $249 — simply by putting your knowledge of electronics to work!

As with previous competitions, both DSE and ourselves wanted to make this a competition where our younger readers would have just as much opportunity to win the prizes as those with more experience or knowledge of electronics. But we didn't want it to be a mere lottery or 'game of chance', either... The trick was to come up with a contest which doesn't require a lot of technical knowledge, but will still involve a real challenge to your skills. Here's what we came up with, after a certain amount of head scratching. All you have to do is list as many of the surnames as you can, of scientists, engineers and inventors who have been responsible for the development of modern radio communications technology, using ONLY the letters present in these words:

SANGEAN SYNTHESIZED WORLD RADIO COMPETITION

That's right, as long as you can make up the surname of a radio scientist or inventor from the letters in the above words, they can be added to your list. (You'll perhaps note that we've deliberately spelt 'synthesised' with a 'z', to give you this letter — it might come in handy!)

The 10 neatest entries with the largest number of names for legitimate radio inventors and scientists, made up from only these letters, will win the readers concerned a Sangean ATS 606 World Band Radio. What could be easier?

If you can't come up with enough names from the top of your head, we're sure you'll find as many as you need from past copies of *Electronics Australia*, and if necessary from an encyclopaedia. There have been an enormous number of people, over the last couple of hundred years, who have contributed to modern radio technology.

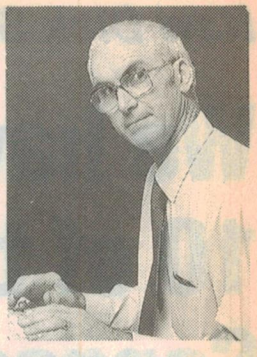
Here's a suggestion, though: if you come up with some really obscure names, it may pay you to include their full name, country, date of birth and the discovery or invention they are credited with — just so we can confirm that you haven't made them up!

But don't delay! You only have until the end of October — your entry must be postmarked no later than October 29, 1993. Note that no employees of Dick Smith Electronics or Federal Publishing Company, nor their families, are eligible to enter this competition; also that our judges' decision will be final, and no correspondence can be entered into following the judging...

Post all entries to: 'Sangean Radio Inventors' Competition, c/- Electronics Australia, PO Box 199, Alexandria 2015. There is no fee for entering, but you must pay the postage for your entry!

FORUM

Conducted by Jim Rowe



Is Australia more interested in safety than economic survival?

We're taking a complete break this month from some of those topics that seem to haunt this column perpetually (perhaps they'll need a stake through their heart, if ever they're going to be put to rest?). I've received a couple of letters and faxes on some quite different matters, and I think you'll find them rather interesting. One comes from a reader in Hong Kong, who has 'had a go' at us all collectively on a previous occasion.

Many readers of this column will probably recall a fairly critical letter we published in the 'Letters to the Editor' column of the May 1992 issue, taking me to task for comments I had made in the January 1992 editorial, about the forthcoming postage rate increases.

The letter came from an expatriot Aussie who nowadays lives and runs a business in Hong Kong, Dr Peter Crowcroft, and he castigated me for what he saw as the insularity, 'backward thinking' and lack of innovation displayed by *EA*, myself and Australians in general. In his view Australia was virtually a 'sinking ship', being left behind by the rest of the world, and anyone with a bit of gumption and instinct for survival would simply leave and join the 'real world'.

Well, Dr Crowcroft has sent me another of his missives, this one in response to an item which we published in the Serviceman column of the June 1993 issue — with pictures and comments about a fairly crude welding transformer which a reader had purchased in Hong Kong.

Like his first letter, this one seemed to be intended simply for publication in the Letters column. However because the points he raises in it are quite interesting, I thought we'd publish it here and see if other people would like to comment on it.

Incidentally I note that recently a project based on a kit developed and sold by Dr Crowcroft's company in Hong Kong has been published in a certain other local magazine, run by a former colleague of mine. Presumably Dr Crowcroft doesn't think Australians are now totally beyond the pale, then — at least when it comes to seeking customers. But it's beginning to look as if he does see *EA* as something of a *bete noir*, representing all that he dislikes about Aussie electronics, and essentially a vehicle to vent his spleen. Such is life, I suppose...

Anyway, here's what he has to say in this latest rocket:

Since I spend about equal amounts of time in Australia and in Hong Kong, it was interesting to read your correspondent's comments about low safety standards here (EA, June 1993 p49.) Might I proffer an alternate explanation?

I would advance the thesis that Australia has too much safety, rather than Hong Kong having too little. I would submit that the sacred cow of 'Safety' is now simply a shield behind which a multitude of Government self-interests have clustered. For example, indirect taxation (speed cameras) and the keeping of thousands of civil servants employed in paperwork enforcing a plethora of useless safety standards, interfering in every aspect of life with the sole aim of keeping themselves in jobs and actually having nothing to do with safety.

I would argue that enforcing this 'useless' safety is partly responsible for pushing manufacturing industry and jobs overseas to less sanctimonious countries. Did R.H. use the welder in question? Did it work? Could he have bought a 'more safe' welder had he so wished? Of course he could; but he did not. Hong Kong allowed him full freedom to buy the welder of his choice. And that is what he did. Instead of the top of the range German model, he went for the lowest Chinese model from the PRC.

Please tell me why there should be some Authority to dictate which he should buy? R.H. is really complaining about having the full freedom to choose, and yearning for the Government paternalism that is Australia today.

That welder is but one of the million things here which translates bottom line into cheaper goods in the Australian retail stores, which YOU buy in preference to the more expensive Australian-made products, 'Buy Australian' campaigns notwithstanding. So please no disparaging thoughts about me, if you have any 'Made in China/Sri Lanka/Thailand' toys, electrical or white goods in your house. You cannot criticise supposed low safety standards (let alone no environmental ones) on the one hand, then directly finance them with the other!

From an Australian point-of-view I also agree with your correspondent that the Hong Kong Chinese are 'very strange people to work with'.

One vignette: on several occasions, in order to get out an order, I have worked alongside 10 or so local men and women in an un-airconditioned 'factory' until 3am — a straight 17-hour day — with no complaints from them, let alone union reps negotiating compensation, accountants calculating triple time trigger points, etc. I was able to sleep-in the next day; the others all clocked on by 10am. Very strange people.

I agree with you that R.H. left out a lot from his letter, especially if he was busy negotiating for another contact to return here!

Finally, let me end on a positive note by agreeing with you about the pitiful way Australia adopts new technology (Editorial, July 1993.) As I write this I have on the BBC and CNN, and I tune in and out of them as interest takes me. When I come to Australia I feel like I am leaving the real world. I wonder if

Canberra's bureaucrats have used 'Safety' as one reason for the Pay TV delay?

Well, there you are, folks — what do you think? It would be all too easy to dismiss the points Dr Crowcroft makes, concluding on the basis of this and his earlier critical letter that he was simply some kind of embittered and aggressive ex-pat with an axe to grind. But I think if you look at both letters objectively, you have to conclude that there's a fair bit of truth in what he says.

We *are* restricted...

To my mind at least, Australia's manufacturing industries in general — and particularly the electrical and electronics industries — *are* now quite severely hobbled by too many restrictions, imposed and enforced by a veritable army of bureaucrats. And many of these restrictions *do* seem to have been imposed for supposed safety reasons, at least nominally — although like Dr Crowcroft I'm inclined to suspect that this is often either bureaucratic self-justification or essentially just a manifestation of the overall dependence on Government/bureaucrat paternalism that now seems to infect so much of our society.

It's also undeniable, I think, that we Australians are now quite hypocritical when it comes to buying cheaper goods, from countries which we delight in criticising for their low standard of living (meaning people working for very low wages, under conditions we wouldn't tolerate), in preference to buying competing goods from our own factories — because they're inevitably more expensive. We want *our* Government and bureaucrats to enforce all of the safety and other regulations they can dream up for our 'protection', but at the same time we want to be able to buy cheaper goods from overseas — made by people who lack all of this protection. It's called 'having one's cake and eating it too', isn't it?

But on the other hand, is the answer for Australia simply to drop all of its regulations covering appliance safety and employee working conditions, as Dr Crowcroft seems to be suggesting? Is this really the only way to rescue Australia's industries and join what Dr Crowcroft proudly calls 'the real world'? I for one hope this is not the case — to be honest, the cure seems an awful lot worse than the disease.

It's an interesting subject, though, isn't it? I can see what Dr Crowcroft is getting at; a lot of the time our Governments and bureaucrats seem to spend more effort trying to ensure that no-one can ever be hurt using a machine or appliance — even if they do something quite stupid — than they do in trying to encourage our manufacturers to actually use the machines to make the appliances. But where *do* you draw the line, when it comes to safety — and working conditions?

Perhaps Dr Crowcroft is right, and *we* need to move a bit closer to the Hong Kong model, instead of them moving closer to us. I'll be interested to hear your comments.

MDS and Pay TV

Moving along, you might recall that in the June issue we also carried a story written by Barrie Smith, on the potential for microwave MDS (multipoint distribution systems) to be used for delivery of Pay TV, and trying to discover why the Federal Government had vetoed the idea. Well, this article too has attracted some criticism, in this case from reader John Martin VK3KWA of Mitcham in Victoria. Mr Martin is actually co-ordinator of the WIA's Federal Technical Advisory Committee (FTAC), although he seems to have written the letter in a private capacity. From Mr Martin's letter, it's

fairly clear that he wasn't at all impressed with some of the comments made in Barrie's article:

I have just read the article 'Pay TV via Microwave' in your June issue. I assume that the material was supplied to you in the form of a press release, because it contains a number of astounding ideas which seem to defy the known laws of physics.

Some of these are as follows:

- ***'19 channels available per market NOW'***

How so? Have the existing services in the 2.07 - 2.11GHz and 2.3 - 2.4GHz bands been evicted already? Where is the empty spectrum space for these other services to move to? How do the pay-TV people intend to use all channels in every service area without any co-channel interference? Presumably no two service areas will be adjacent to each other.

- ***'Any areas in shadow can be accessed by repeaters'***

On what frequencies? Can they guarantee that on-frequency repeaters will work in every site, without feedback from reflected signals?

- ***'38 channels available through digital compression NOW'***

Amazing. Only a few months ago they were telling us that digital compression (as proposed for Aussat) was 'unproven', and the analog AM system used by MDS channels was great.

- ***'Quality of signal: MDS better than free-to-air'***

MDS uses the same 7MHz wide, VSB AM system as free-to-air TV. How will they make it better? Since the program material would be converted to PAL from overseas NTSC satellite feeds, how can they get better resolution than they started with?

- ***'DBS satellite signal quality: VHS standard'***

Tell that to the TV networks that use Aussat feeds all the time. All this time they have believed they were getting broadcast quality feeds!

- ***'Local council approval for dishes: MDS no, DBS yes, in many cases'***

There are plenty of satellite dishes a few feet above the ground, or on garage roofs not visible from the street. Every MDS antenna must be higher than surrounding obstructions. Do local councils prefer high antennas to low ones?

- ***'MDS has 85% coverage'***

Of what? Obviously they mean 85% of the few service areas they intend to cover. The article stated '200 towns and cities', '20 key locations', and '85% of the population living in 31 centres'. Which is the real figure?

- ***'Microwave is line of sight — as with VHF and UHF TV'***

No difference over such a frequency range? Then we should need dishes for VHF, or rabbit ears would do for microwave. That will amaze all the people who can receive VHF TV but can't get SBS. It will certainly amaze anyone who knows anything about propagation.

- ***'Every cricket match is carried by microwave from the ground to the TV station'***

In one hop, through hills and buildings? Using a dish you can hold in your hand?

- ***'The few remaining shreds of Senator Collins' technical credibility'***

He said that MDS 'gets interfered with by houses, trees, storms', etc. I thought he did quite well. Someone must have given him a few 'shreds' of factual advice. Maybe he would only be credible if he denied the obvious!

- ***'All have operating MDS stations. So why not in Australia?'***

I thought we did have MDS. It's all those point-to-point links that would be thrown out of their band to make way for pay-TV. Exactly the same as throwing out VHF FM broadcasting years ago, to make way for more TV channels. Just another 'quick fix' using someone else's spectrum space.

Electronics Australia has been a prestigious journal, and it is disappointing that you have lowered your standards by letting an article like that slip through without checking it for technical accuracy.

Well, as you can see Mr Martin seems to have been pretty upset by the article. So much so that reading his letter, I couldn't help but wonder if at least some of his anger was caused by a fear that if MDS was used for Pay TV, he and other radio amateurs would lose their access to the current amateur bands at 2300 and 2400-2450MHz...

Barrie's response

Anyway, in view of his rather severe criticisms of Barrie Smith's article in particular, I thought it would be only fair to give Barrie the opportunity to respond with his own comments. Here's the reply that came back:

SUBJECT: AUSTRALIS/MDS

To answer Mr Martin's letter, I approached David Jupp, Chief Engineer of Australis Media Pty Ltd — operators of the MDS group covered in EA June. Each question is listed as Mr Martin has given it, but the latter's extended questions-cum-answers have not been included. Mr Jupp and I offer the following comments:

Q. 19 channels available per market NOW?

A. There is only one service in use now, which is not intended for subscription television, and I refer to the AAP Data Service. All others which are not taken are intended for use or are being used for 'PAY'. There are a couple of markets, namely Canberra (four channels) and Sydney (one channel) being used for Television STLs. There is no intention of moving them yet. Any areas in shadow can be accessed by repeaters. All repeaters will be the same frequency and opposite polarity. Receive antennas are very directive.

Q. 38 channels available through digital compression NOW?

A. A digital compression system for DBS does not exist unless you are prepared for a $5500 JPEG receiver. 2:1 compression at a realistic price exists for MDS; however 8:1 and 16:1 systems have also been tested for MDS with a cost penalty. Analog meantime will do just fine!

Q. Quality of signal: better than free to air?

A. Point taken. MDS is equal to free to air. Ghosting however can be virtually eliminated by the parabolic type antenna used for MDS.

Q. DBS satellite signal quality: VHS standard?

A. This refers to compressed DBS. A full transponder or half transponder at the Optus costs will not work; compression therefore is essential. The first stage in compression is generally to low pass filter the video to combine as many signals as possible. The pass band has generally been 3.5MHz after removal of chrominance information.

Q. Local council approval for dishes: MDS no, DBS yes in many cases?

A. Some councils have indicated a DA and BA would be required for a satellite antenna. This is more prevalent in high density and 'upper class' suburbs. MDS could still use a small patch antenna in these circumstances.

Q. MDS offers 85% coverage?

A. 85% of wherever DOTAC will licence a service. Obviously the operators will not provide transmitters for 19 channels to service 20 households.

Q. Microwave is line of sight — as with VHF and UHF TV?

A. MDS is truly line of sight. If you cannot see a transmit tower, you don't get it. Repeater transmit antennas however can be accurately directed. Melbourne is perfect for MDS. Sydney, on the other hand, will require a number of repeaters.

Q. Every cricket match is carried by

microwave from the ground to the TV station?

A. This just points out that microwave technology is in common use by television networks. Outside broadcasts generally would be higher than 2.5GHz, therefore short haul.

Q. The few remaining shreds of Senator Collins' technical credibility?

A. Senator Collins completely changed his statement. MDS suffers interference from houses, trees, storms, etc. — but so does Ku-band satellite transmission. I've yet to see MDS wiped out by rain, even heavy rain, but I can't say the same about Ku satellite: there's double attenuation during a rain storm in Sydney. Would you ask for a rebate for the month of February a few years back, when it rained heavily for nearly the whole month? Yes, the networks use satellite, but with 6-13 metre dishes.

Q. All have operating MDS stations. So why not in Australia?

A. MDS is an acronym for Multipoint Distribution Service; a point-to-point link is not MDS. I guess you could say that Australian spectrum authorisation has been badly managed for years.

Since the article appeared, MDS has now gone two ways and offers true interactivity. Fibre optics, however, will eventually take over.

Well there you are, folks (and Mr Martin). I think you'll agree that David Jupp and Barrie Smith have clarified at least some of the points that Mr Martin queried, and the original article doesn't seem to have been all that terrible after all.

Mind you, I'm still a little mystified about one or two points, I must confess. For example I'm not quite sure what an 'STL' might be (standby transmission link?), or a 'DA and BA' for that matter.

Puzzling suggestion

I'm also a bit puzzled by the suggestion that digital compression systems don't exist yet for DBS, but do exist for MDS — having seen a demonstration of MPEG-2 digitally compressed video via DBS only a few months ago, as I reported in our May issue. The receiver used was certainly a fairly fancy 'commercial' grade unit made by Scientific-Atlanta, but I'm not aware of really low cost MDS receivers being available with decoders for digitally compressed signals.

My understanding is that chip sets for MPEG-2 decoders will be available before the end of the year, and I can't understand why they shouldn't be at least as applicable for DBS as for MDS. In fact I've heard suggestions that MDS is *less* suitable than DBS for digital transmission of any kind (compressed or not), due to the greater incidence of multipath distortion.

So there may be a few points that still need clearing up in all this — but don't forget that it's a field where the technical and commercial developments are coming thick and fast. What seems to be impossible now could be sitting in our lounge rooms a few years from now...

Service manuals

To round things up this month, I have a little item which I spotted in a recent issue of *Tastronix*, a newsletter published jointly by the Tasmanian divisions of TETIA (The Electronic Technicians' Institute of Australia) and TESA (the Television and Electronic Services Association). It's about a firm, located in NSW, which actually hires out service manuals — although only to service technicians at present.

I thought this would be of interest, because of the complaints we often get from readers regarding the lack of technical information supplied with electronics gear — and also the letter I published in the August column from Robert Gott of Toowoomba, suggesting that manufacturers should at least include a schematic and basic data in the form of a fold-out 'map'. Until something like this happens, we're still going to need access to conventional manuals — which can often cost $30 or more.

Anyway, here's the item as published in *Tastronix*:

SERVICE MANUAL HIRE

Have you ever struck a situation where you needed a particular service manual, but the job didn't warrant the trouble and expense of buying a copy? It might have been an old video recorder and the customer didn't want to spend too much on it. You know the story?

If you were lucky, you could borrow a manual from a friend — which is OK if the friend has one and lives close by. But most of us just struggle through, and curse the complexity of modern appliances and the high cost of the relevant service manuals.

Well, now there is a solution to the problem. A firm in Cooma (of all places) has a library of around 9000 manuals and will lend you the one you need for just $5.00 a month.

High Country Service Data was once a service organisation at Moss Vale, but as it developed into a data supply facility, they closed the repair side of their operations. The company now runs a mail order manual rental service as well as a computer database and BBS.

***Manual rental:** The service manual rental is available to bona fide organisations and to individuals actively engaged in the industry. They prefer to charge through a recognised credit card for small or occasional transactions, but 30-day credit facilities can be arranged for regular users.*

Orders for manuals can be placed by mail, fax or via the computer BBS. The first month's rental includes seven to 10 days for postal transit. If the manual is not returned on time, a further month's rental is charged automatically. Up to nine manuals can be listed on any single order, but there is no limit to the total number than can be booked out to a particular customer at any one time.

High Country Service Data states that they have no objection to borrowers copying manuals (subject to copyright laws), except that they must be treated carefully, and staples or bindings MUST NOT be removed.

***Copies for sale:** They suggest that if you find you need to retain a copy of the manual, it is better to purchase a copy from them since you would then have a copy of the original, rather than a copy of a copy. Not all brands are available under the 'For Sale' service, but there are enough to justify an enquiry.*

High Country Service Data can be contacted by mail to Private Bag 3, Cooma NSW 2630, by phone on (064) 525 322 or by fax on (064) 525 301.

(The Bulletin Board Service can only be accessed by personal application to the company. A one month 'Test Drive' is allowed.)

An interesting development, isn't it? The services the firm is providing will no doubt be of great value to service technicians everywhere, and they deserve to succeed.

The rest of us?

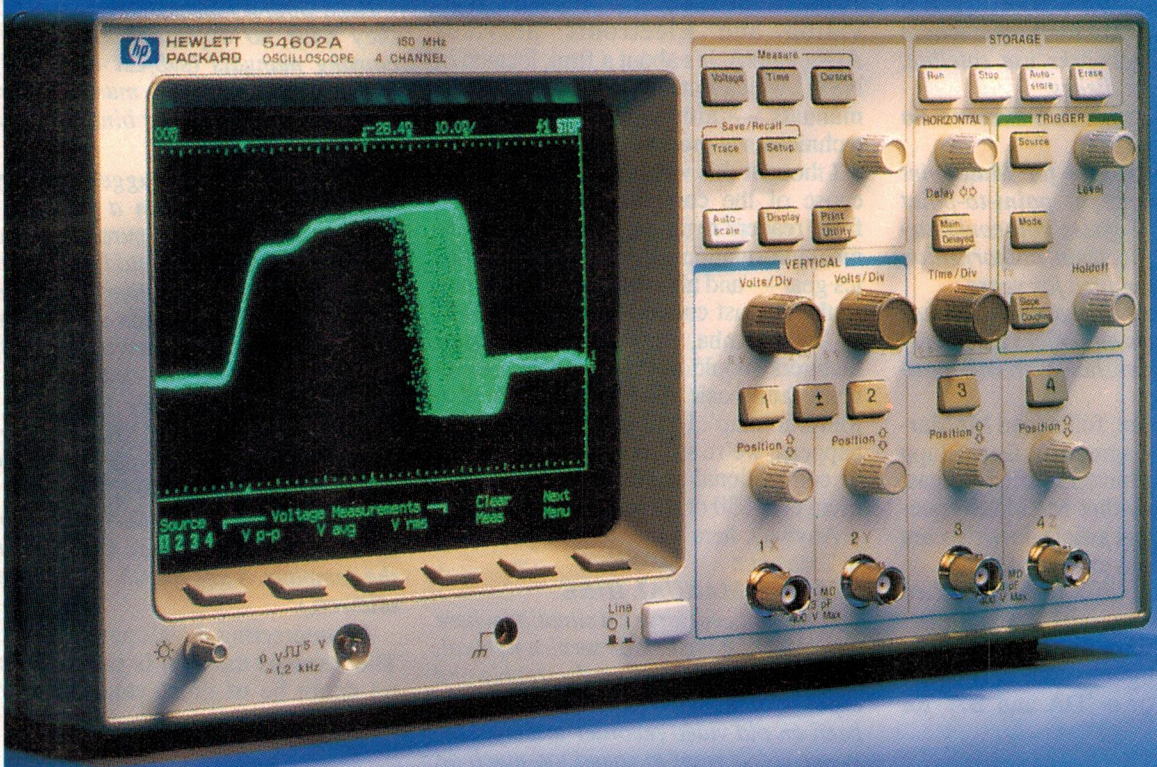
Perhaps they'll also consider extending their services to people who are not 'in the servicing trade', but are still technical enough to tackle repairs to their own equipment. After all, our money ought to be as good as that of the professionals, surely.

I don't know about you, but I'd certainly be happy to pay a few dollars for a copy of the schematic and PCB overlays for some of my gear, to help me fix it when it needs attention. High Country Service Data might be sitting on a little goldmine there down in Cooma, if they choose to extend their market a little.

And that's it at the Forum for another month, folks. I hope you'll join me here again next time. ❖

Win a

Hewlett – Pack



ard Oscilloscope with FFT

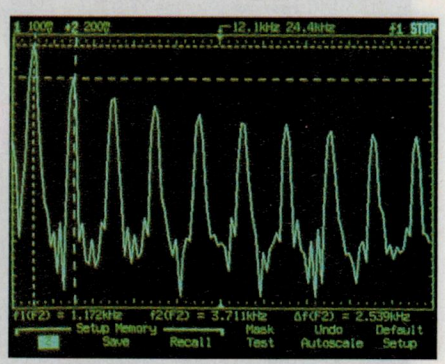
Two of these superb Hewlett-Packard, HP54601A 'analog feel' four channel 100MHz digital sampling oscilloscopes to be won when you subscribe to Electronics Australia. That's right, if you subscribe or renew your subscription to Electronics Australia before 26/1/94, you can have an excellent chance of winning one of these highly praised state of the art instruments. We have two of them available, by courtesy of Hewlett-Packard Australia, and each unit is complete with the HP54658A Fast Fourier Transform (FFT) Measurement/Storage module at a further $1,264, this gives a value for each prize of $6,173 or over $12,000 for both prizes.

The HP54601A digital scope is a compact instrument which combines the ease of use, display update speed and display 'confidence' of a traditional analog CRO with the additional performance and features of a modern digitising unit. It offers an effective bandwidth of well over 100MHz for repetitive signals, with the two main channels having an input sensitivity down to 2mV/division and the two 'logic' channels a sensitivity down to 100mV/division. There's a comprehensive range of triggering facilities, plus of course features like waveform storage and the ability to perform automatic measurements of a large number of waveform parameters – such as peak-to-peak, average or RMS voltage, frequency or period, rise and fall time, and pulse width. And the screen display is updated at the rate of one million data points per second. giving virtually instant response!

The HP54658A adds powerful additional measurement and communications facilities to the HP54601A. These include further waveform maths functions (including of course FFT processing to show the frequency-domain components of a signal) , additional automatic and cursor-based waveform measurements, up to 100 non-volatile trace memories, time and date tagging of both stored and hard-copy waveform printout, and a full RS-232C serial data interface for connecting the instrument to a computer or printer.

In short, each HP54601A/54658A combination forms a very high performance integrated measurements system, making it of great value not only to electronics professionals but to serious enthusiasts as well.

To subscribe simply phone toll free 008 800 933 with your credit card details ready. **A SUBSCRIPTION COSTS $47 FOR 12 ISSUES INCLUDING POSTAGE.** If you don't have a credit card fill in the card attached.



HEWLETT PACKARD

HOW TO ENTER: Simply phone our toll free number 008 800 933 and have your credit card details ready. If you do not have a credit card then fill out the coupon attached and post. If the coupon is missing, send your name, address, phone number and cheque to: Federal Publishing Company, Reply Paid No. 3, PO Box 199, Alexandria NSW 2015. Any enquiries can be made by phoning (02) 353 9992. Unsigned orders can not be accepted.

CONDITIONS OF ENTRY: 1. The competition is only open to Australian residents authorising a new or renewed subscription to Electronics Australia before last mail on 26.1.94. Entries received after closing date will not be included. Employees of the Hannan Group., Hewlett Packard Australia LTD., their subsidiaries and families are not eligible to enter. 2. South Australian residents need not purchase a subscription to enter, but may enter once by submitting their name, address and a hand drawn facsimile of any coupons to the Federal Publishing Company Pty. Ltd., PO Box 199, Alexandria NSW 2015. 3. Prizes are not transferable or exchangeable and may not be converted to cash. 4. The judge's decision is final and no correspondence will be entered into. 5. Description of the competition and instructions on how to enter form a part of the competition. 6. The competition commences 29.9.93 and closes last mail on 26.1.94. 7. The draw will take place in Sydney on 28.1.94 and the winners will be announced in a later edition of Electronics Australia. 8. The prize is 2 x HP54601 valued at $4909 each. 2 x FFT module valued at $1264 each. Total prize valued at $12,346. 9. Subscriptions are not refundable. 10. The promoter is the Federal Publishing Company Pty. Ltd., 180 Bourke Rd, Alexandria NSW 2015. Permit No. TC93/0000 issued under the lotteries and Art Union Act 1901; Raffles and Bingo Permit Board No. 93/0000 issued on 00/00/93; ACT permit no. TP93/0000 issued under the Lotteries Act 1964; NT permit No. 93/000.

HOW THEY MADE THE ATOMIC BOMB - 2

My first article about Los Alamos probably made it seem like such a jolly place, but one tends to forget what it was there for: to design and manufacture an instrument of death. At night the people of Los Alamos played, partied, and made babies. But during the day they worked feverishly to produce — the gadget. It was not referred to as the bomb, just the 'gadget'. Perhaps if one didn't invoke its real name, one would forget what it was for. Then again, the enemy wouldn't know what a 'gadget' was, until it was too late.

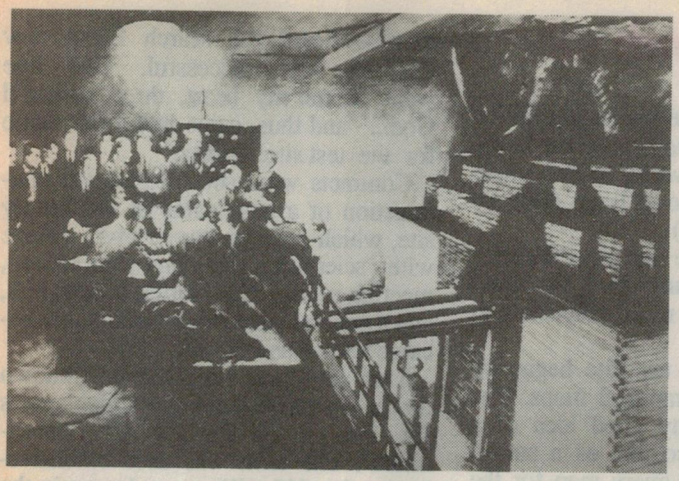
by TOM MOFFAT

The whole concept of nuclear energy was first demonstrated when Enrico Fermi got a controlled chain reaction going in a reactor built under a grandstand at the University of Chicago. Massive energy was released, and it became obvious to researchers that if the energy could be released all at once, it would result in an explosion many times greater than anything seen in the world up to that time.

As World War II took its grip, the American government, which showed little interest in atomic fission at first, decided the war could be finished quickly with one big nuclear bang. The Manhattan Project was thus formed, with bomb development concentrated at Los Alamos.

Fission takes place when a large atom is split into two approximately equal parts. 'Approximately', because some neutrons are released which are not part of either resulting new atom. The fission process also releases energy, and nuclear radiation. If the neutrons streaming out from the split atom collide with other atoms, they can cause them to split too, releasing still further neutrons and more energy.

If there are enough nearby atoms for the free neutrons to collide with, they release further neutrons, which collide



On the left is where it all started — the first chain reaction under the grandstand at the University of Chicago while at right is the base camp at the Trinity test site. Opposite: The author, Tom Moffat, is pictured with replicas of 'Little Boy' and 'Fat Man' — two bombs with totally different detonation devices.

with further atoms, and the process becomes self-sustaining. This is known as a *chain reaction.*

Obviously there is a certain amount of fissionable material, below which too many free neutrons escape instead of colliding with more atoms. With an amount larger than this, enough neutrons collide with other atoms to support a chain reaction. This exact amount of fissionable material is known as the *critical mass.*

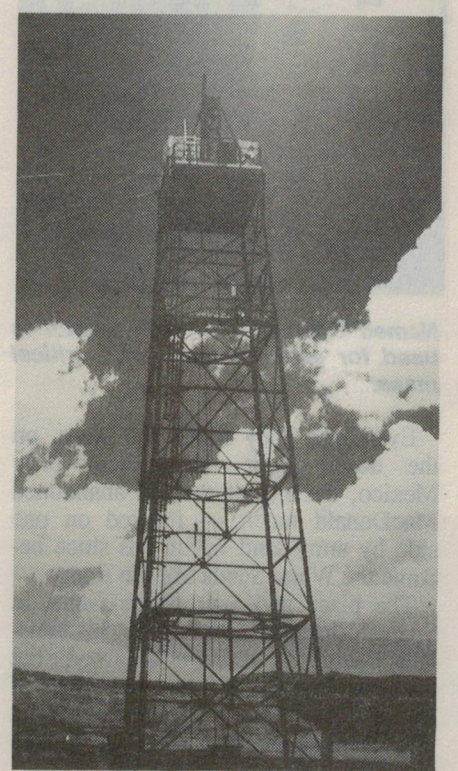
In a nuclear reactor, there is somewhat more than a critical mass of fissionable material, with holes through it so that graphite rods can be moved in and out of the 'core'. As the rods are lowered inward they get in the way of some of the free neutrons, 'moderating', or controlling, the chain reaction. The chain reaction releases lots of energy as heat, which can be used to boil water — to generate steam and spin a turbine. This is the basis of a very simplified nuclear power station.

The graphite control rods are attached to a mechanism that raises and lowers them by electromagnets. If something goes wrong with the reactor, the power to the electromagnets can be cut off, releasing the control rods — which drop all the way into the core under the force of gravity, hopefully stopping the chain reaction altogether.

This is the purpose of the 'SCRAM' button on the reactor's control panel, mentioned last month. In the event of a power failure, loss of power to the electromagnets will let the control rods drop as well.

The water being boiled acts as a coolant for the core. Should the water supply fail, core temperature will rise, and the reactor's control circuitry should sense this and let the rods drop. If the temperature rise happens too fast, or is not sensed, the core can distort, trapping the control rods so they can't drop. The reactor then 'runs away' in an uncontrolled chain reaction, and we have *meltdown.*

Note that an out-of-control chain reaction does not explode; it simply generates enough heat so the critical mass is destroyed. The destruction might be quite violent, but it is not a nuclear explosion. And as a mass is brought to the verge of being critical, free neutrons in the earth's environment can set it off early, resulting in a nuclear fizzle. And here we have the reason why it was such a damnably hard job to build an atomic *bomb.*



This is the tower at ground zero at the Trinity test side. It was completely vapourised when the bomb went off.

For a nuclear explosion to take place, it is necessary to produce a critical mass very quickly and hold it together long enough for the emitted neutrons to produce fission of the whole works, instead of blowing it apart by sheer heat alone. The early bomb scientists thought this could be done by starting with two or more subcritical masses, and blowing them together with a chemical explosive such as TNT.

Reactor experiments showed that there were two elements that might be forced into such a supercritical state that they would produce a nuclear explosion: uranium 235 and plutonium 239. It was thought that U235 might not be so reluctant to get going, but P239 would produce more explosive power — even though it was harder to set it off in the first place. As well, plutonium was easier to come by in those days.

Little Boy, Fat Man

Different methods were devised for making the two elements go supercritical, and these resulted in two completely separate bomb designs being pursued side-by-side.

One design, for a 'gun' bomb, had a code name of Little Boy. A more complex version, an 'implosion' bomb, was called Fat Man. The gun bomb was devised for U235, which was easier to set off. Here the uranium was formed into two parts, each smaller than a critical mass (I am told unofficially that a critical mass is a chunk about the size of a grapefruit).

Each half is mounted at opposite ends of a long tube, with a large explosive charge behind one half. When the charge is exploded, that piece of uranium is

How they made the Atomic Bomb - 2

propelled along the tube as a projectile, which slams into the stationary piece at the other end. The two join as one, in a supercritical mass, and BOOM! You have your atomic bomb.

The trouble is that the speed of the 'projectile' part of the fissionable material, even racing down a gun barrel, is not quick enough to set off plutonium. As well, the material is only approaching criticality from one direction.

Everything could be much quicker and more efficient if there were many chunks of material, each less than critical mass, which could be brought together from many directions, over shorter distances, to a meeting place in the centre of the bomb.

This is the basis of the second model developed at Los Alamos, the implosion bomb. Here plutonium was arranged loosely around a central point, with the overall density of the stuff less than a critical mass. The plutonium was surrounded by a 'tamper' material, designed to deflect escaping neutrons back into the plutonium, and the whole works was surrounded by a high-explosive charge.

The idea was to set off the explosive charge from all directions at once, quickly compressing the plutonium to criticality and holding it together, bound by the tamper to prevent any neutrons getting away. But this was easier said than done, because of the difficulty of getting the explosive to go off all at once. A chemical explosion is actually a fast fire, which starts somewhere and spreads somewhere else.

Scientists and engineers had a real hassle, working with shaped charges and timed detonators, to produce an explosion that would concentrate all its energy into the centre at exactly the same instant — an implosion.

There were many booms and bangs in the scrub out behind Los Alamos, as different explosive schemes were tried out, and eventually the researchers came up with something they thought would work. But would it work?

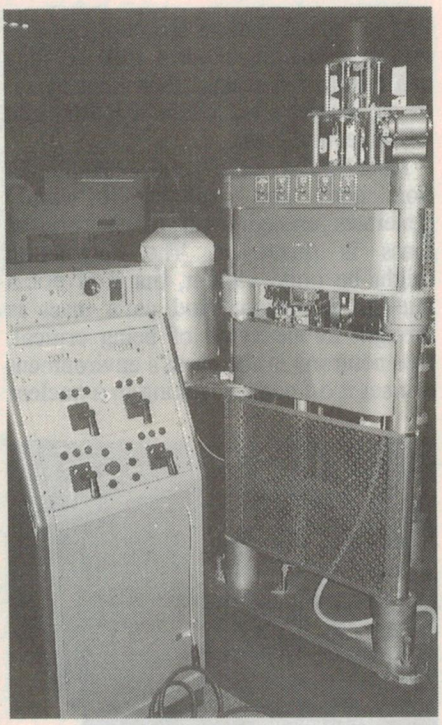
There was only one way to find out — give it a try in a real atomic bomb. Los Alamos began building the first Fat Man.

Search for a site

One does not casually let off atomic bombs in the scrub out behind Los Alamos. Although they'd never seen one, the researchers knew whatever happened was going to be *big*. In fact Enrico Fermi was prepared to bet that the bomb would destroy the world, or the whole state of New Mexico at least. (Was he joking? Maybe not...)

So the place for the first test site had to be a long way from anywhere, for safety reasons as well as to make it invisible to prying eyes.

The search for a test site began by pouring over topographical maps. The military had a pretty good idea of a spot in New Mexico, but as a smoke screen they ordered every map for the entire states of Colorado, New Mexico, and California.



Named Godiva, this small reactor is used for experimenting with critical mass.

Eventually they found the place, on the desert floor in southern New Mexico, the site of the old abandoned MacDonald ranch — flanked on one side by army land which has since become the White Sands Missile Range.

The place had a prophetic name, in Spanish: Jornada del Muerto. This translates literally as 'Route of the Dead'; but my own interpretation saw it as 'Work of Death'. Anyhow, not a real pleasant place, and considering what was to take place there, the name fitted well.

J. Robert Oppenheimer, scientist in charge at Los Alamos, had been reading a book called *Holy Sonnets* at the time he heard the search for a new test site was successful. One line went 'Batter my heart, three person'd God...' and thus came the new name for the test site: Trinity.

Contracts were soon let for the construction of a base camp at the Trinity site, which soon became a small village with scientific labs and workshops, meeting rooms, dormitories, a mess hall, and a general purpose storeroom that became known as FUBAR.

This may have been the first known use of the classic acronym which stands for 'F——d Up Beyond All Recognition'. The term was used extensively in the US military, and even in the Bell Telephone Company where I worked for a while. The FUBAR label was reserved for equipment that was so far beyond repair that it was only fit for the tip.

Jornada del Muerto was truly a horrid place. It abounded with scorpions and rattlesnakes and other nasties, and people living at Trinity base camp had to make sure they shook out their clothes each morning before putting them on. The most intense work took place in the middle of summer, and the heat was truly unbearable. A beer ration was organised to prevent dehydration; it was for medicinal purposes only, of course.

Ten miles from the base camp was Ground Zero, the site where the gadget would be tested. Here was built a 100-foot tower, with a little hut on the top where the gadget would be housed. The hut was crammed with instrumentation, with data cables heading away to protected recording sites 10,000 yards distant (to this very day, test site distances are measured in thousands of yards). That's roughly 10 kilometres.

When the gadget itself was brought from Los Alamos, it was in pieces. The original MacDonald homestead, about 5000 yards from ground zero, was used as the assembly building for the gadget.

The plutonium core was installed and the shaped explosive charges (called lenses) were set in place, and then the gadget was moved to a concrete blockhouse directly under the tower at Ground Zero. There it remained until the day of the test.

But what if it was a dud? Fat Man contained half the world's then available supply of plutonium. If it was a fizzer, it would still produce a violent chemical explosion that would scatter the plutonium all over the desert.

This had been a worry all along, and schemes had been developed to explode the gadget in a pool of water to trap the plutonium, or in an underground pit. But

the scientists felt the only way they could extract valid data from the test was to have the gadget above ground, as if it had been dropped from an aircraft.

Jumbo, too

Then somebody got the idea of enclosing the gadget in an immensely strong pressure vessel. It was thought a housing could be built that would survive the blast of the shaped charges, if the bomb was a dud. Afterward, they could scrape out the plutonium and re-use it. But if a nuclear explosion did occur, it was felt the vessel would vapourise as if it wasn't there in the first place.

While Fat Man was being built, another team went flat out designing the pressure vessel. This monster was 12 feet in diameter and 25 feet long, and it weighed 215 tons. It soon became known as Jumbo.

The vessel was fabricated in a commercial foundry (which didn't have a clue what it was making) and then transported as close to Trinity as possible by train. Then a 64 wheel low-loader, custom made for Jumbo, took over and made the laborious journey across the desert to Ground Zero.

And then — it was decided not to use Jumbo after all!

The bomb designers had become confident that the gadget would indeed go off, and they feared that Jumbo's presence would affect the experimental results. So Jumbo was stood on end several hundred yards from Ground Zero, propped up by a steel frame, to await the detonation. What would the blast do to it?

After months of frenzied activity, everything was ready. At 8:00am on Saturday, July 14, 1945, the gadget began its final journey up the tower and through a hole in the floor into the hut on top.

The floor was then replaced and the bomb was lowered back into position. The Fat Man squatted there, waiting for his moment in history; a 13-pound blob of plutonium surrounded by 5000 pounds of high explosives.

With everything ready, dignitaries from all over America streamed into Trinity to view the test. Enrico Fermi was there, waiting to see if the world would end. And of course Oppenheimer was present; after all, Fat Man was his baby.

Scientists and politicians from all over the country arranged phoney travel plans to secretly make their way to Trinity. They were to observe the test from the three instrumentation sites 10,000 yards from Ground Zero, or from the Trinity base camp.

The big test

The test was planned for 2:00am on Monday, July 16. And like so many operations on test ranges right up to this very day, everything was touch and go, messed up primarily by the weather. It would rain, the countdown would be delayed, the rain would stop, the countdown would be readied again, and then it would rain.

The smallest atomic bomb ever made. The woman has her eyes closed so she won't be blinded if it goes off.

Finally, at 5:09am, the automatic countdown timer was started and the test was under way. The timer was to run for 20 minutes and then hand control to another precision timer, which would run for a few seconds, triggering various recording instruments and film cameras at just the right instant before the explosion. A voice countdown went out over the site's radio network... five, four, three, two, one, NOW!

The Fat Man did his job well. A fireball bloomed, hundreds of times brighter than the midday sun. The bomb generated a terrible blast wave. The observers turned their backs just before detonation, and were slammed by a wave of heat. Everyone wore welding goggles to protect their eyes, and when they turned back toward ground zero they saw towering columns of red and orange fire, building into the world's first mushroom cloud.

The blast sounded like a loud crack, which then rumbled and reverberated through the Jornada del Muerto for a full five minutes.

Those who saw the blast were thrilled, and terrified, all at once. The explosion was easily seen and heard in Albuquerque, and even at Los Alamos by people who were clever enough to climb to hilltops at the appropriate time.

After the radiation settled down, the scientists moved in to ground zero to see what had happened. All that was left of the 100-foot tower and the concrete shelter at its base was a few pieces of reinforcing rod sticking out of the ground. The tower and the concrete blockhouse had both vapourised.

All around ground zero the desert sand had melted, and then re-fused into glass. This material became known as Trinitite, and many observers went home with chunks of it as souvenirs. As a young boy I was the happy recipient of a piece of Trinitite, which took the place of honour up on the shelf with my rock collection.

As I was researching this article I mentioned to a US government official that I had scored a piece of Trinitite as a kid, and he became very stern very quickly. Where is it now? We want it back! It turns out that Trinitite was reeking with radioactivity, and now the government is trying to get every fragment of it back to safely bury it someplace. I lost my piece of Trinitite years ago, as kids tend to do.

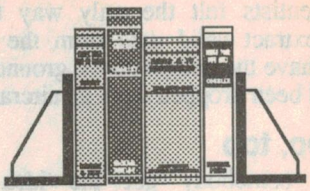
Back to Trinity and the aftermath of the test. Sitting off to one side, amidst all the destruction, was Jumbo — quite unperturbed. The vessel had survived the explosion completely intact. This was the cause of some embarrassment, because millions of dollars had been spent on Jumbo's development and it had never been used.

The Congressional waste-watch committee would not be impressed. So the army decided to remove the evidence, by the simple expedient of packing Jumbo with explosives and blowing it sky-high. But Jumbo was a rugged old beast, and it wouldn't be moved. All the explosives did was blow a small hole in the side of it.

The scientists were furious at what the army had done; they had planned to use Jumbo in other experiments. But Jumbo

Continued on page 97

NEW BOOKS



Digital systems

DIGITAL SYSTEMS REFERENCE BOOK, edited by B. Holdsworth & G.R. Martin. Published by Butterworth-Heinemann, 1993. Soft cover, 240 x 185 x 50mm. ISBN 0-7506-1758-6. Recommended retail price $110.00.

This massive reference covers digital systems information under five general headings: fundamentals, devices for digital systems, system design and techniques (software and hardware), system development and applications. It took three years to search for the more than 50 authors, and then edit their 64 contributions.

Part 1 covers fundamental information, including mathematical techniques, Boolean algebra, and combinational and sequential logic; while Part 2 contains practical information on devices used in digital systems, like logic families and medium-scale integrated circuits, through to processing devices.

A survey of high-level languages, interfacing (both digital and analog), real-time techniques and testing for design, occurs in Part 3. Part 4 concentrates on system development, with topics like software engineering techniques, simulation, CAD, and system commissioning and testing. The final part contains a number of contributions on applications in a variety of fields, such as satellite systems, audio engineering, telephony and control systems.

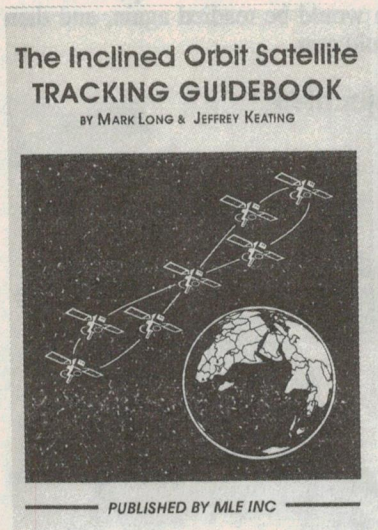
The book is well presented and illustrated, and very readable. It contains a wealth of detailed information on just about every aspect of digital techniques.

The review copy came from Butterworths, 271-273 Lane Cove Road, North Ryde 2113. It should be available from technical bookshops. (P.M.)

Satellite TV

THE INCLINED ORBIT SATELLITE TRACKING GUIDEBOOK, by Mark Long and Jeffrey Keating. Published by MLE Inc., 1993. Soft covers, 220 x 285mm, 94 pages plus fold-out charts. ISBN 0- 929548-12-4. Recommended retail price $49.95 plus $6 packing and postage.

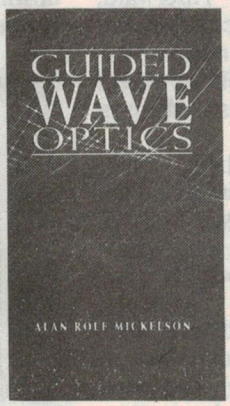
Due to the delays worldwide in getting new satellites up into orbit, caused by various launch vehicle failures, many operators of existing satellites have had to extend their operating life. Often this has meant allowing them to drift into inclined orbits, to conserve orbit-correcting thruster fuel, and then installing improved tracking systems in their terrestrial base stations to cope with the resulting 'wobble' or apparent figure-of-eight cyclic movement of the satellite as seen from a point on the Earth.

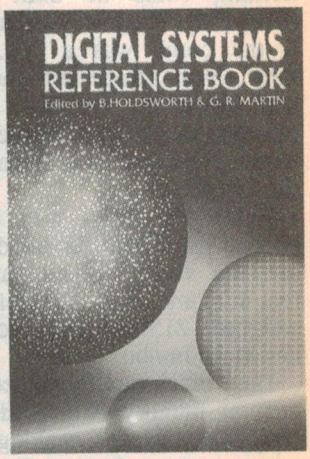


In this new book, the first I've seen that deals with this subject, the authors explain the full implications of inclined orbit operation for satellite TV reception. They show in detail how the 'wobble' arises, its detrimental effects on path gain and the ways these problems can be overcome — including better antenna mounts and tracking systems. They also give quite a bit of specific information about the known status of various satellites around the globe, and fold-out charts showing both C-band and Ku-band satellites.

There's a lot of very handy information, then, which should make it of great potential value for anyone 'into' satellite TV or communications in a serious way.

Two copies of this book actually arrived for review, one from AV-COMM of PO Box 225, Balgowlah 2093 (phone (02) 949 7417) and the other from Peter Lacey Services of 80 Dandenong Road, Frankston 3199 (phone (03) 783 2388). Both firms are offering the book by direct mail order. (J.R.)





Text on optics

GUIDED WAVE OPTICS, by Alan Rolf Mickelson. Published by Van Nostrand Reinhold, 1993. Hard cover, 235 x 158mm, 254 pages. ISBN 0-442-00715-9. Recommended retail price $131.95.

The author has written this graduate level text to emphasise the unifying concepts of the field of guided wave optics. It gives equal emphasis to the waveguide, semiconductor laser, fibre and integrated optic component; and its unifying tools are the forms of Maxwell's equations in polarisable media and its coupled forms.

Designed to follow after a course in physical optics, the book emphasises basic concepts, yet is quantitative in nature and contains numerous applications.

Following an overview of Guided Wave Optics in chapter 1, the other five chapters deal with Slab Waveguides, the Semiclassical Laser Equations, Semiconductor Lasers, Optical Fibres and Integrated Optics. There are numerous graphs and diagrams as illustrations, and each chapter has a series of relevant problems.

Apart from the overview, the treatment of each chapter is very mathematical in nature, which means that you can't skim through the book to get an introduction to the topic. It is definitely a specialist text which needs to be studied in detail.

The review copy came from Thomas Nelson, 102 Dodds Street, South Melbourne 3205. It should be available from technical bookshops. (P.M.) ❖

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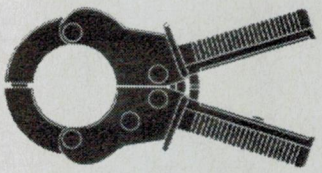

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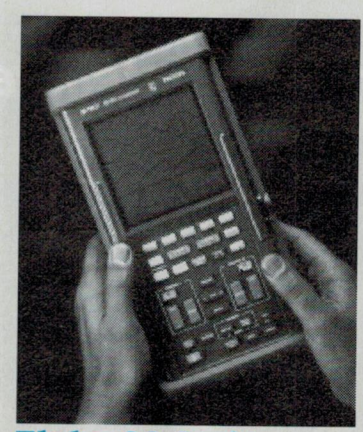

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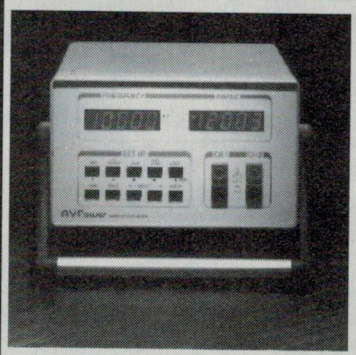

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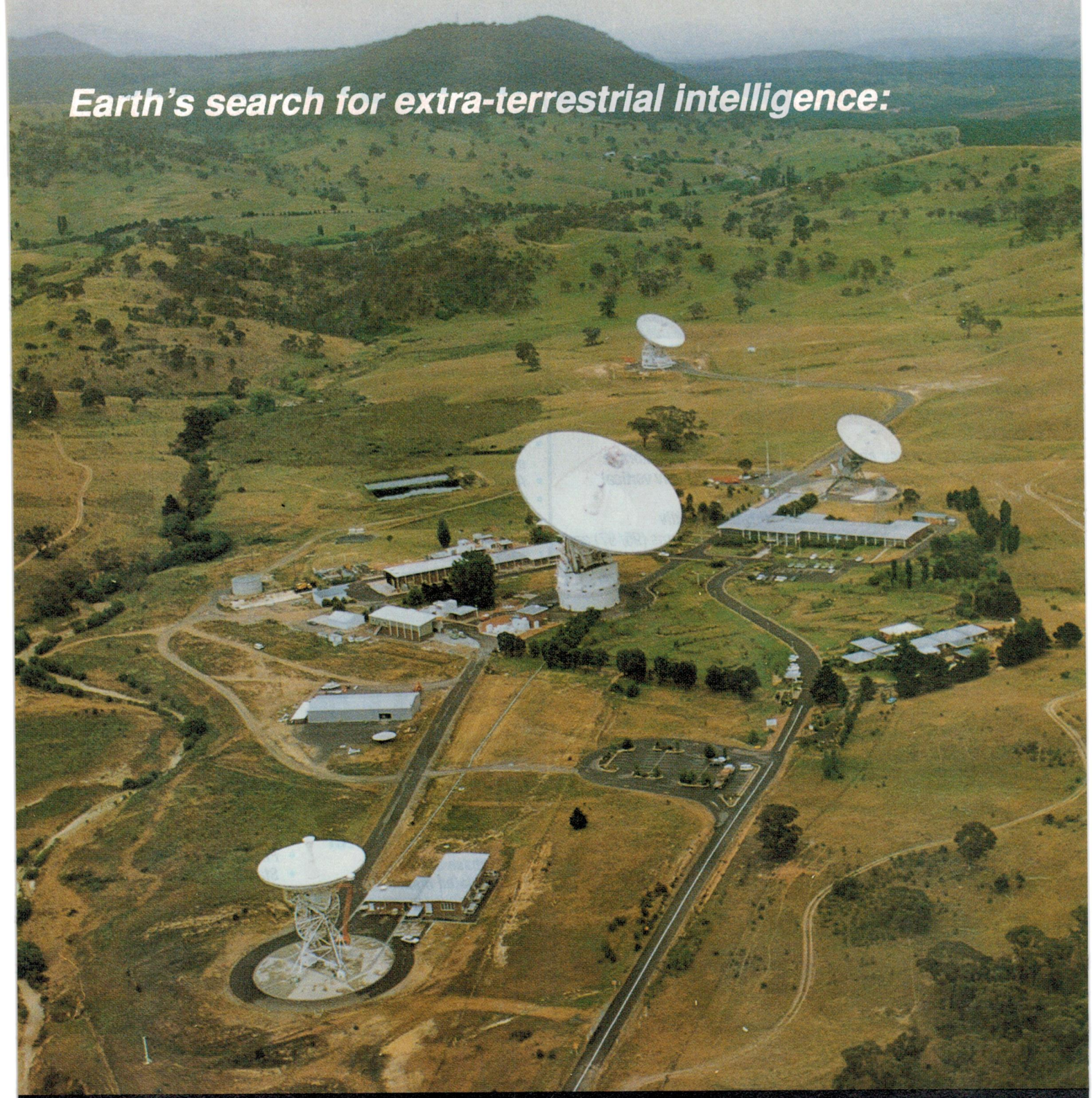


IF YOU HAVEN'T HEARD MUCH ABOUT NASA'S SEARCH FOR EXTRATERRESTRIAL INTELLIGENCE OR 'SETI' PROJECT LATELY, THAT'S NOT BECAUSE IT ISN'T CONTINUING — IT HAS MERELY BEEN RENAMED. NOW KNOWN AS THE HIGH RESOLUTION MICROWAVE SURVEY OR HRMS, IT IS PROGRESSING AS PLANNED, WITH HIGH-TECH EQUIPMENT AND LEADING EDGE DATA ANALYSIS TECHNIQUES BEING USED TO SEARCH THE HEAVENS FOR RADIO SIGNALS WHOSE PARAMETERS DISTINGUISH THEM FROM NATURAL EMISSIONS...

ARE WE ALONE?

by KATE DOOLAN

One of the most fascinating questions that we human beings often ask ourselves and each other is 'Are We Alone'? To consider the answer to this question, first remember that our planet Earth is an insignificant speck of dust orbiting an obscure star in an equally obscure galaxy which makes up a small part of the Universe. After considering this question, now think about how large the universe is and how many star systems could have planets orbiting them; and the possibility of life on those planets.

On 12 October 1992, five hundred years after Christopher Columbus discovered America, the USA's National Aeronautics and Space Administration (NASA) started another voyage of discovery — one which could revolutionise life on Earth just as Columbus did all those years ago.

The High Resolution Microwave Survey (HRMS), formerly known as the Search for Extraterrestrial Intelligence (SETI), has begun the most comprehensive search for signs of life elsewhere in the Universe. By using radiotelescope and antenna systems, the HRMS project will attempt to detect radio transmissions from intelligent sources in other planetary systems around other stars.

Since ancient times, philosophers, scientists and other curious people have been looking at the skies for signs of life. However, it was not until 1959 that the search began in earnest.

Scientists Giuseppe Cocconi and Philip Morrison pointed out that microwaves could provide a means of interstellar communication. Cocconi and Morrison suggested that a 1.42GHz emission of atomic hydrogen would also make an excellent 'hailing' frequency.

The following year, astronomer Frank Drake began Project Ozma, targeting the stars Tau Ceti and Epsilon Eridoni for signs of intelligent life. Even though it was a modest program, Project Ozma was an extremely bold step for its time.

In the late 1960's, NASA began making requests for funding under the name of Project Cyclops, which would be a sprawling series of telescopes and scanners looking for intelligent life elsewhere.

The price tag for this would have been US$10 billion, and in the post lunar landing budget cuts, Cyclops got the axe — but not before some damage was done, with extraterrestrial search programs getting an unwanted reputation as a money drain. Senator William Proxmire gave NASA one of his infamous 'Golden Fleece' awards, for wasting taxpayer's money, and also engineered a clause in NASA's appropriation bills that prohibited the spending of any money on SETI programs.

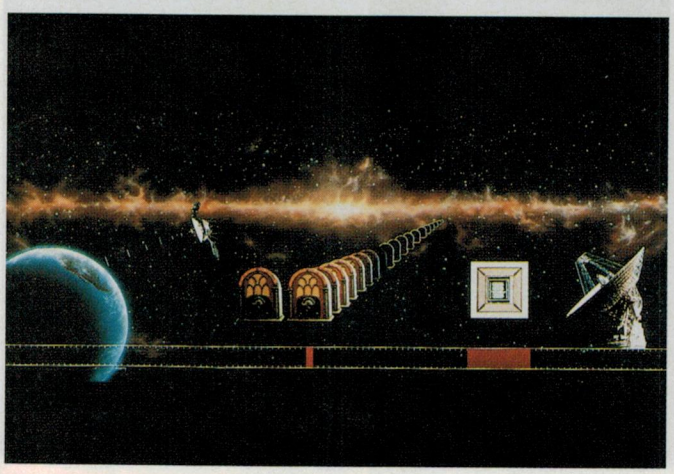
During the seventies and eighties, private individuals and educational institutions did the bulk of SETI research in the United States. After the great success of the film *ET*, director Steven Spielberg donated US$100,000 to The Planetary Society on the proviso that it was to be used for SETI purposes. The Planetary Society, the largest space interest group in the world, was by that stage funding several SETI programs that laid the groundwork for the HRMS program.

In 1987 at an international space conference, NASA's then Administrator Dr James Fletcher surprised everyone by announcing that the SETI program would be the most important project that NASA could carry out in the next two decades. The following year, NASA submitted a proposal to Congress requesting funding for the Microwave Observing Project (MOP) — a cutting edge, super computerised signal detection and processing system that would do more searching in a minute than had been done by all previous SETI projects.

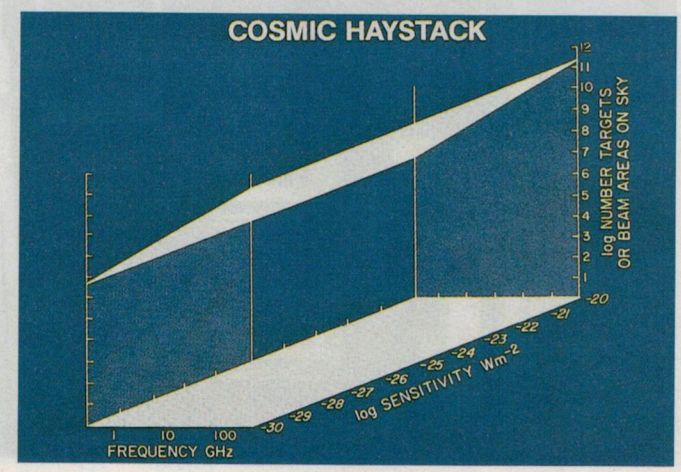
In 1989, Congress approved the MOP program, which would cost a modest US$100 million over its ten-year life. In comparison, a single space shuttle flight can cost up to US$350 million, while the Hubble Space Telescope cost US$1 billion to build.

Two surveys

The High Resolution Microwave Survey consists of two parts: a Targeted Search and a Sky Survey. The Targeted Search uses radio telescopes from all over the world to search the frequency range from 1GHz to 3GHz (1000 - 3000MHz), seeking a variety of patterns of an artificially generated signal. Started from the Arecibo Observatory in Puerto Rico, the search will be targeting stars less than 100 light

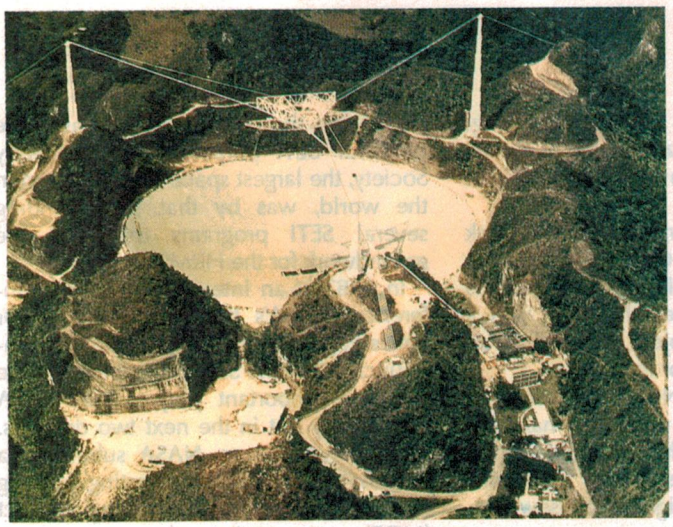


We can listen with a single radio, or even with thousands of radios, but computer technology (illustrated by the chip) allows us to listen to tens of millions of channels.

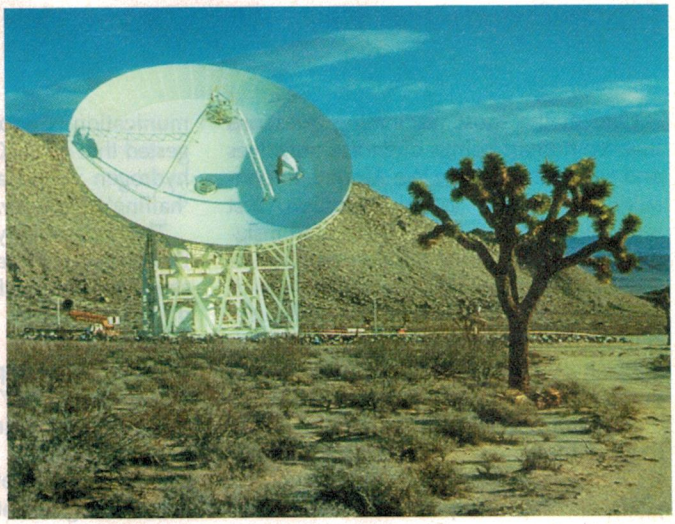


Three of the dimensions that must be considered in searching for a signal: frequency, direction and signal strength (related to both size of antenna and power of the signal processing).

Earth's search for extra-terrestrial intelligence



Arecibo Observatory. The 305-metre radio telescope is the largest in the world. The Targeted Search began its observational phase at Arecibo in October/November 1992.



The Goldstone 34-metre antenna. This antenna in California's Mojave desert is part of NASA's Deep Space Network. The Sky Survey began its observational phase in October 1992.

years from Earth. A light year measures 12.9 trillion (12.9×10^{12}) kilometres.

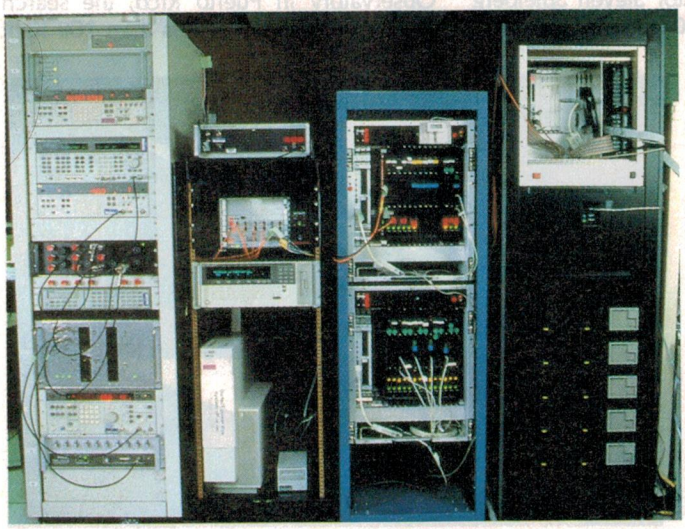
The Targeted Search will be examining 1000 nearby solar stars, to test if extraterrestrial technologies are transmitting radio signals different from the natural sources of radio emissions. It is hoped that the radio telescopes in the HRMS network will be sensitive enough to detect these transmissions. Some stellar clusters and nearby galaxies will also be targeted and observed.

Scientists believe that electromagnetic radiation is the most efficient way for accomplishing information transfer over interstellar distances. All electromagnetic waves travel at the speed of light, but radio waves use lower energy photons than light or other radiation and they are not affected by the interstellar medium. Of all electromagnetic frequencies, the radio portion of the spectrum suffers least from natural background noise. Microwave radio frequencies between about 1GHz and 10GHz allow detection of the weakest signals. In achieving the highest possible sensitivity, the largest radio telescopes available are being used to conduct the Targeted Search. The number of targets being covered is much larger than previous searches, and the range of frequencies is a thousand times greater than all earlier searches combined.

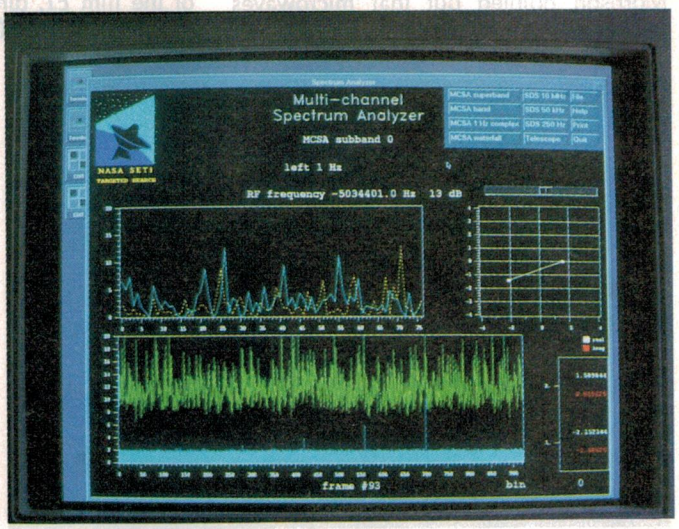
To accomplish this, special digital signal processing equipment will be simultaneously studying the radio spectrum over tens of millions of individual frequency channels, at spectral resolutions ranging from 1, 2, 4, 7, 14 and 28 hertz (cycles per second).

This equipment can detect continous carrier waves or narrow band pulses automatically, whether they remain constant in frequency or drift slowly because of relative acceleration between the transmitter and receiver. Low noise feeds and cryogenically cooled receivers provide access to all frequencies between 1000 and 3000 megahertz.

A Multichannel Spectrum Analyser (MSCA) and real-time pattern recognition



The HRMS Targeted Search System (single polarisation, two more racks needed for the full system) occupies about the same volume as the Project Ozma electronics of 1960.



Targeted Search Spectrum Analyser Display. The plot at middle left shows an instantaneous view of two successive spectra covering 84 channels (or 'bins') each 1Hz wide.

systems have been deployed at radio astronomy observatories which have large existing antennae. The MSCA provides 144 channels with 576Hz spectral resolution, and 74,000 channels with 0.5Hz resolution. The analyser is supported by a VAX 11/750 minicomputer and a SUN graphics workstation, which provide data acquisition and signal recognition capabilities.

Present signal recognition software algorithms demonstrate efficient and near optical detection of continous wave signals and narrowband pulses, whether stationary or drifting in frequency up to +/-1 channel per observational frame. When combined with NASA signal detectors built for the HRMS project, the system is also capable of detecting continuous signals as narrow band pulses, which could be a likely form of interstellar transmission. An automatic data analysis subsystem will be used to detect the signals.

The Targeted Search is using the National Astronomy and Ionosphere Centre's 305-metre diameter radio telescope, located at Arecibo in Puerto Rico, for the initial search. The system will have a total of 10MHz bandwidth and will analyse tens of millions of channels. This system will be transported to other radio telescope facilities around the world in a systematic fashion, over the 10 years of the search.

Australia will be participating in this search, by the use of the CSIRO's 64-metre telescope at Parkes in New South Wales. It is expected that HRMS operations will start at Parkes in 1994.

Sky Survey

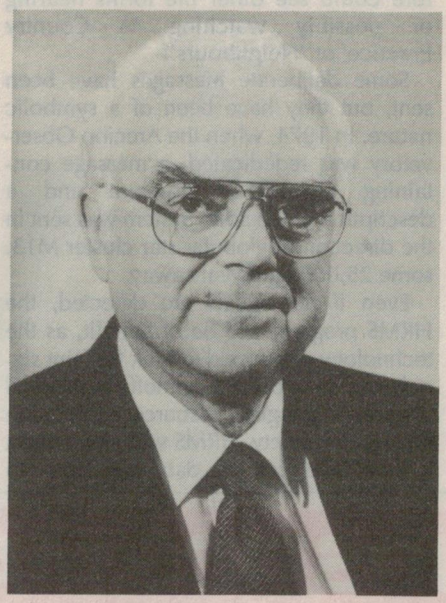
The second part of the HRMS project is the Sky Survey, which will be searching for radio signals in a wide range of frequencies from 1GHz to 10GHz. The Sky Survey observation techniques involve automatically mapping small areas of the sky called 'sky frames'.

As the observations are completed, the sky frames are assembled to form mosiac maps, one for each frequency band, of all the microwave detections over the entire sky. For each of the 31 frequency bands, the sky is divided into several hundred frames and each frame takes two hours to map.

Initially the Sky Survey will be using the 34-metre diameter antenna at the Goldstone Deep Space Communications Complex in California. Goldstone is part of NASA's Deep Space Network (DSN), which is the largest and most sensitive scientific telecommunications and radio navigation network in the world. The DSN has the principal responsibility to support robot interplanetary spacecraft missions, plus radio and radar astronomy observations in the exploration of the solar system and universe.

The DSN has three ground stations at Goldstone, Madrid in Spain and Tidbinbilla in the Australian Capital Territory. The Tidbinbilla complex will be used in the latter part of the survey, when the HRMS search shifts to Australia.

The Sky Survey began operating with a prototype system. This prototype receiver, spectrum analyser and signal processor break up incoming microwave radio signals into two million separate frequency channels. The system can be configured into a single-polarisation mode, with



Dr Frank Drake, who conducted the first search for radio transmissions from extraterrestrial civilisations — Project Ozma in 1960 — could listen on only one channel due to the limitations of electronic equipment at that time.

40MHz total bandwidth, or a dual-polarisation mode with 20MHz total bandwidth. Specially designed digital hardware operating at 'supercomputer' speed will simultaneously process the two million channels, to identify and separate interstellar signals that have artificial characteristics from background radio noise and terrestrial interference from Earth orbiting satellites.

The most promising signals will be subjected to a detailed screening and saved for subsequent verification by the scientific community. The prototype system is also being used to test and verify the design of the Sky Survey control and data processing algorithms.

The operational Sky Survey is currently being designed and built. When finished, it will provide 16 times the capability of the prototype and will feature a 32 million channel spectrum analyser with a bandwidth of at least 320MHz. From 1996, the system will map the entire sky in both the northern and southern hemispheres. This observational phase is expected to last for six years and produce more than 25,000 sky frames.

A 34-metre radio telescope collects, reflects and focuses radio waves from cosmic sources in much the same way that an optical telescope reflects visible light waves. Radio waves from space are collected by the telescope's main dish surface, which reflects them up to a sub-reflector.

This in turn directs the waves down to a feed horn in the pedestal room by way of reflectors in the beam waveguide path. In the pedestal room, the microwaves are amplified by the receiving equipment which is designed to minimise as much noise as possible. This equipment also converts the microwaves into a more manageable band of intermediate frequencies, which are sent by fibre optics to the control room.

In the control room, the Wide Band Spectrum Analyser divides the intermediate frequency band into two million frequency 'bins'. Next, the special purpose processor detects and selects candidate frequency bins where universally high power levels indicate the possibility of a signal. Approximately 100 such candidates are passed on to the signal processing computer. The best candidates for further study are narrow band signals that are re-observable at the same position in the sky.

The candidate frequency bins are then computer analysed and the resulting handful of qualified candidates are stored on computer disks, after which follow-up observations are scheduled. Each of these candidates will undergo intensive examination and re-observation to determine whether any of them have the characteristics of artificially generated signals which the HRMS program is searching for.

If a signal is intentional, it will be 'cryptographic' or easy to decode. To send or receive a signal over interstellar distances, a civilisation would have to understand basic mathematics and science. They would possibly compose the message with simple tutorial pictures and use an interstellar language based on universal mathematical or physical principles. Signals that a civilisation uses for its own purposes may be difficult to decipher and radio emissions may have no detectable message content. However, scientists may be able to deduce basic facts about the distant society sending the message.

When and if contact is made, a special protocol has been produced and is to be followed. The 'Declaration of Principles Concerning Activities Following the

Earth's search for extra-terrestrial intelligence

Detection of Extraterrestrial Intelligence' was developed over a period of several years by the SETI committee of the International Academy of Astronautics, with the assistance of experts in the SETI field.

The document is intended to be a series of guidelines for individuals and organisations engaged in carrying out radio searches for contact. Included in the declaration are the following points:

- If a discovery is made, the discovering organisation has to have the signal verified by two independent sources.
- After the verification is made, the public must be informed immediately by scientific channels and the media.
- The data has to be made accessible to anyone who wants it, especially in the scientific community by the means of meetings, publications and conferences.
- To protect the frequency, the International Telecommunications Community has its own procedures in place to ensure the frequency is not used. There have been no procedures defined covering a reply to the message; it will be up to the nations of the planet to decide whether to reply, and how to reply to the message.

Listening only

The HRMS program is designed only to listen for signals, and not send them. Since the beginning of the century, we have been unintentionally transmitting signals into space. These signals take the form of radio, communications and television transmissions as well as military radar. The television shows of the fifties and sixties have travelled out into space for more than 40 light years, so the future could see other life forms hearing or possibly watching 'A Country Practice' or 'Neighbours'!

Some deliberate messages have been sent, but they have been of a symbolic nature. In 1974, when the Arecibo Observatory was rededicated, a message containing our DNA structure and a description of the Solar System was sent in the direction of globular star cluster M13, some 25,000 light years away.

Even if no signals are detected, the HRMS program will be of benefit, as the technology developed to look for faint signals can be applied to spinoffs in medical diagnostic imaging, resource exploration and aircraft safety. HRMS will also collect a complete set of data available to astronomers to assist them in other discoveries.

The original title of the program, the Search for Extraterrestrial Intelligence, has been changed by NASA to the current one of the High Resolution Microwave Survey because both American politicians and the public have the perception that HRMS is either a search for little green men or UFO's — neither of which have anything to do with this program.

The HRMS program is in fact part of the new NASA program 'Towards Other Planetary Systems', and is managed by the Solar System Exploration Division of the Office of Space Science and Applications at NASA Headquarters in Washington DC.

So the search has now started, and soon we may finally learn whether we are alone or not. But the answer may generate more questions, and change our whole concept of where we stand in the overall scheme of things.

In closing, the author wishes to thank Bob Arnold of the Ames Research Centre and Mary Hardin of the Jet Propulsion Laboratory, for their assistance in preparing this article. The photographs shown are by courtesy of Ames Research Centre. ❖

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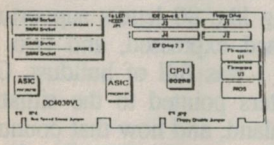

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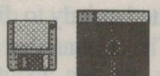

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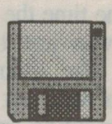

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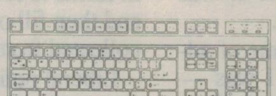

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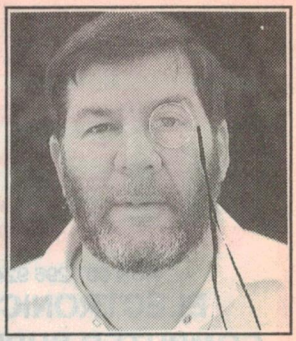
Moffat's Madhouse...

by TOM MOFFAT



Three years of madness!

Well, doesn't time fly! You are now reading Moffat's Madhouse number 36, representing three years of uninterrupted brilliance, mindless opinionated balderdash, or self-indulgent drivel — depending on your point of view. Three years ago Editor Jim Rowe gave me the go-ahead to give this Madhouse thing a try, warning that magazine columns are notoriously short-lived. I must admit I was surprised to see Madhouse survive a year, but here we are three years down the track and still going.

During this time I have got lots of comments from readers, not specifically as letters, but usually as notes tacked on the bottom of orders for my project kits. Those who like what they read usually tell me; those who don't like what they read seem more likely to write to the Editor. Then he sends me photocopies of *those* letters — Oohhh! I can't bear to think of them!

For all you people who have written, and wondered, I will now try to give you an idea of what other people are thinking about some of the things raised in Moffat's Madhouse, starting with the bad news first.

I suppose the column that brought the worst response was the one I wrote about video games and the violence they depict to kids. I mentioned a particular shop which openly let kids play games in which the participants routinely disemboweled or beheaded each other. Yet magazines with pictures of naked women were kept far out of the kids' reach. I expressed the opinion that I would rather have my son gazing at the female form than pressing buttons to rip a fellow human being to shreds, even if it was simply an image on a TV screen.

Many people wrote accusing me of advocating pornography. I guess I was — but only as being preferable to mindless violence. I don't really think there is a place for either in this world, but I guess I didn't really make that clear. Sorry!

The most liked column was the one about Gort the robot, his boss Klaatu and their attempts to make war a thing of the past. This one was written just as the Gulf War was threatening to explode into a full-blown global disaster. Gort and Klaatu were the stars of the film *The Day the Earth Stood Still*, which I first saw as a 12 year old boy. Its anti-war message stuck with me for life, and when the film re-surfaced again as a video I knew it was going to be my vehicle to comment about the futility of war in Moffat's Madhouse.

I fully expected to be branded a 'snivelling commo peacenik wimp' after that column, but the response was just the opposite. People who wrote thought the column was most appropriate, and it expressed the fears many of them felt that the nuclear bombs could start flying at any moment. I guess the whole business gave us all the shudders, watching the World Powers slinging Scud and Patriot missiles at each other while the rest of us waited quietly to die.

The column that most *polarised* readers was the one about that Goods and Services Tax which the Liberal Party had planned to inflict on Australia. I expressed an intense fear that as a small businessman I would be obliged to act as a tax collector for the government. This would result in a sea of personal red tape, while giving the government full details of what I considered to be my private business affairs.

At the time the column was written the GST, was just beginning to be talked about. The thoughts expressed in the column were not just mine, but those of others running one-person or two-person businesses, such as TV and video repair services and barber shops. They were terrified about spending all the extra hours to fill in tax forms. They would have to fill in forms to recover GST paid to suppliers, and then fill out more forms to remit GST collected from customers.

Liberal politicians railed at me for inaccuracy. One *demanded* that I write to him for the 'official' party explanation of the GST. But that very week, I had already been sent the 'Guide to the GST' brochure by the Liberals' Tasmanian branch. This document, although a little murky, seemed to confirm much of what I had written. I had worried about weekly reporting of GST for the taxman; the brochure claimed it would have to be done once every three months, but Dr Hewson himself said it would be once a month. Whom do you believe?

Once the election campaign got going, the Libs claimed that any business with less than $50,000 turnover could 'opt out' of the GST system. But how can this be, if it was to be a universal tax? Does that mean I would not have to charge GST on the electronic kits I sell? Not very likely!

Overall the column on the GST brought something like 80 letters supporting the fears I had expressed, and two letters claiming I was full of bulldust. One of these letters pointed to the situation in New Zealand, and how that country had prospered under their GST. But this letter was somewhat nullified by a Kiwi who made a very expensive phone call to tell me that the fears I had expressed had come true in New Zealand. He issued a passionate warning that Australia must not fall into the GST trap.

As it turned out, Australia rejected the GST in a big way, which immediately brought comments from the defeated party that Australian voters were not intelligent enough to vote correctly. My own opinion is that Australian voters had infinitely more intelligence than the Libs gave them credit for, and they just wouldn't swallow an election manifesto that had a new tax as its main feature. (No more letters, thanks, the GST issue is dead.)

Another interesting controversy surrounded the column in which I expressed the view that Graphical User Interfaces (*a la* Windows) were the silliest idea ever imposed on computer users. Whether you love or loathe GUI's is really a matter of personal preference, and it certainly brought a lot of comments.

The split here was very close to 50-50, for and against. A lot of the 'against' letters seemed to go to the Editor, so as not to insult me by calling me a dickhead to my face. The matter was then treated to a full discussion in the Forum column. There were even rude comments dropped onto the message areas of computer bul-

letin boards. The gist of these was that Tom Moffat, by not accepting Windows, was a computer illiterate.

On the other hand, letters to me usually said things like 'It's about time somebody exposed this great con job, being perpetrated on the public by greedy software developers...' One guy hit it right on the head when he said he received an unwanted copy of Windows when he bought a new computer. He cleared it out of the system and then renamed it 'Curtains'. By golly there are some clever people out there. *You* should be writing this stuff, not me.

Remember the column about time travel and transmitting matter electronically? I thought that would be a nice innocuous piece, raising possibilities of things that yet remain to be invented. But this one brought some nasty reactions about how *Electronics Australia* was not the place for science fiction.

I recently saw a 50 year-old copy of the American *Radio-Electronics* magazine in which they predicted such things as videotape recorders, communications satellites, and pocket pagers. I'll bet the author of that article, one Hugo Gernsback, copped a bit of flack too. The predictions of course came true, and Mr Gernsback went on to become probably the world's most famous and respected electronics writer.

I sometimes muse that if I were just now coming out of university, and if I could get someone to fund it, I'd like to make it my life's work to find a way of transmitting matter electronically, or travelling through time. Somebody will do it eventually; I just hope I'm alive to see it, and *maybe* even experience it.

There has been some debate about whether subjects of a 'general' nature should be appearing an an electronics magazine. Some people feel very strongly that Madhouse should be electronics-only, or not at all. But the majority seem of the opinion that alternative subjects give some light relief from all the technology.

I think readers will agree that *Electronics Australia* is not an easy magazine to read. If you want easy reading, you should stick to Phantom comics. Some very advanced technologies are discussed herein, and it is sometimes necessary to study an article, read it more than once, to get everything from it. This is meant as a compliment; the articles are usually 'information packed' and take a certain amount of digestion before one fully understands what is being said.

As an example, I've been following Major Al Younger's series on Automotive Electronics. I have recently purchased a late-model car with electronic fuel injection and all the other mod cons, and I found it most distressing to realise I am totally ignorant of how such things work. My motoring knowledge went no further than my 1968 Holden. Now I read — sorry, *study* — Al Younger's articles. They take a lot of concentration, but they are slowly advancing against the vacuum in my brain.

In the midst of all this, we need to have somewhere to rest and take our minds off the hard stuff. So I consider Moffat's Madhouse to be the pan of water, in which to plunge one's aching feet after a long trudge through technology. You won't learn much from Madhouse, but maybe you'll have some fun.

A lot of people ask where the ideas come from; in my experience, most of mine appear in bed. You know how it is when you lie there, mulling over the events of the day. Once an idea starts rolling, whole paragraphs of text fall into place, and I suspect at least some of this takes place while I am technically 'asleep'. When I wake up in the morning, I start typing furiously before the dreamed-up text begins to dissolve; it's not very strongly recorded. With the laptop computer I use, it's not even necessary to get out of bed. So how's that for the height of decadence?

Things that don't get written straight away end up on a list of subjects to be tackled in the future. The current list is full of all kinds of little surprises to drop on you unsuspecting readers. It even doubled in size overnight a while back. The local newspaper was upgrading its image and adding several columnists to its roster, and I asked to be considered. It would have been nice to get a bit of work (and recognition) in my own home town. But when they saw the Madhouse-style stuff I gave them, they said 'No Way!' That was my first-ever rejection in 15 years of writing.

But, in preparation for my stardom as a leading newspaper columnist, I had started working on a big list of column subjects — so I wouldn't run dry when the time came to start producing copy on a regular basis. Now the paper won't be needing them, so guess what! You're going to cop them. The paper's gain is your loss.

I guess now is the time to thank all the people who have followed, and commented on, Moffat's Madhouse. I know it sounds trite, but I really do get a big kick when I open an envelope and see something like 'Moffat's Madhouse is the first thing I turn to...' Well, if you people can put up with it, I can keep dishing it out! So here's to another three years! ❖

Special 'Learn While You Build' Construction Project:

BUILDING YOUR OWN AM-FM PORTABLE RADIO - 1

The best way to learn how a radio receiver works is to build one yourself. The trouble is, in recent years it really hasn't been easy to do this. But here at last is a project that makes it possible again. Available as a kit that's complete down to the last 'nut and bolt', it not only lets you teach yourself the basics of radio reception, but when finished provides you with a very practical AM/FM portable — one which looks just like a ready-made radio.

by JIM ROWE

Back in the 'old days', a couple of decades ago, it was fairly easy to get all of the parts needed to make a fully functional radio receiver. This made building your own radio quite a practical proposition, and many young people and other newcomers to electronics got their first 'hands on' learning experience building one. A radio project makes a good first project, too, because you can put it to immediate use when it's finished.

Unfortunately two things happened during the intervening years. One was that many of the parts needed (like tuning capacitors, dials, cases and so on) became quite hard to obtain. The other thing was that ready-built radios became available at such low prices that building your own became less attractive anyway.

Despite this, there's been a steady stream of requests, both to *Electronics Australia* and to our major retail advertisers like Dick Smith Electronics, for help in this area. Obviously a lot of people realise instinctively that building a radio is an excellent way to learn how they work, and they really DO want to be able to do so!

That's great, of course. And happily, it's now going to be possible again — because after much persistence, the kit buying people at DSE have finally been able to track down a well-made and complete AM/FM portable radio kit. It comes from a reputable Asian manufacturer, and uses the same Sony high-performance LSI radio chip that is used in many of today's commercial portables.

The kit goes together to make a compact and attractive medium-sized superhet portable, with a performance very similar to that of ready-made models of around the same price.

It features both AM and FM reception, a 75mm speaker, a geared-down 'slider' tuning dial for convenient tuning, inbuilt AM rod and telescopic FM antennas, and jacks for both an earpiece and an optional external 4.5-volt DC power supply (such as a 'plug pack'). It's also designed to be water resistant, and even offers 'mod cons' like muting between stations on the FM band.

In short, it's a very practical radio kit, and one that should be ideal for anyone who wants to 'build one to see what's inside them, and how they work'.

By the way, the kit is exclusive to Dick Smith Electronics. It has just been added to their stock as Cat. No. K-1042, and is priced at $49.95.

Superhet basics

Before we turn to see how the kit goes together, let's build the groundwork with a quick refresher on how a superhet radio works. The superhet (short for 'superheterodyne') was invented by US pioneer Major Edwin Armstrong way back in 1918, as a way to get improved reception using the relatively poor valves and other parts they had at the time. It turned out to be such a good idea that it has formed the basis for most 'serious' radio receivers ever since — right up to the present.

The basic idea of a radio receiver is of

Here's what the finished radio looks like. Your friends will scarcely believe you built it yourself!

course to take the jumble of tiny signals picked up by the antenna system, separate the wanted signals from the rest (using a *bandpass* filter, which only lets through a small group of frequencies) and then amplify these to reach a practical level. The amplified wanted signals can then be demodulated or 'detected', to discard the 'carrier' and leave only the original speech or music information — the 'audio'. This can then be amplified and fed to a loudspeaker or earphones.

A fairly basic radio therefore has at least one tuneable RF bandpass filter to select the wanted signals, an RF amplifier, a detector (either AM or FM as appropriate), an audio amplifier and a speaker. Many of the early receivers in fact used this 'TRF' or *tuned radio frequency* system, but it has definite limitations.

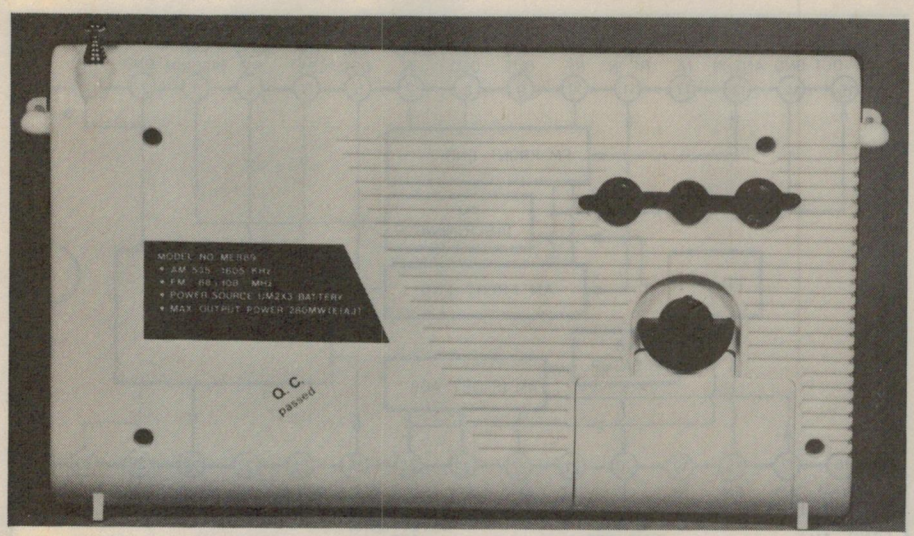
One limitation is that it isn't easy to make a *tuneable* bandpass filter — especially one that doesn't vary its bandwidth (the band of frequencies it lets through) as you tune it to select different centre frequencies. The other limitation is that when all of the amplification ahead of the detector has to be done at the incoming RF carrier frequency, it isn't easy to achieve a good signal-to-noise ratio.

Both of these limitations tended to be especially severe back when Armstrong was trying to build a better radio. His stroke of genius was to realise that the way around the problems was to have a receiver which didn't try to do all of the signal selection and amplification at radio frequencies — but instead do a broad initial selection of the wanted signals and then 'move' them down to a fixed lower frequency, where they could be filtered and amplified much more easily.

The method he chose to move the signals down in frequency was *heterodyning*, where a continuous sinewave signal from a 'local oscillator' is used to multiply or *mix* with the incoming signals, so that the two beat together (like musical notes) to produce new signals at the sum and difference of their frequencies.

By tuning the local oscillator so that its frequency remained a fixed distance away from that of the wanted signals, and taking the *difference* signal from the mixer, Armstrong was thus able to heterodyne the incoming signals down to a fixed and lower 'supersonic' *intermediate frequency* or 'IF', where they could be properly filtered and amplified before detection.

The 'superheterodyne' name which Armstrong coined to describe this ap-



The rear end looks very similar to that of most other portables, as you can see. The strange looking knob at lower right is the catch which secures the lid of the battery compartment. Above are the gaskets for the earphone and DC sockets.

Build your own AM-FM portable radio - 1

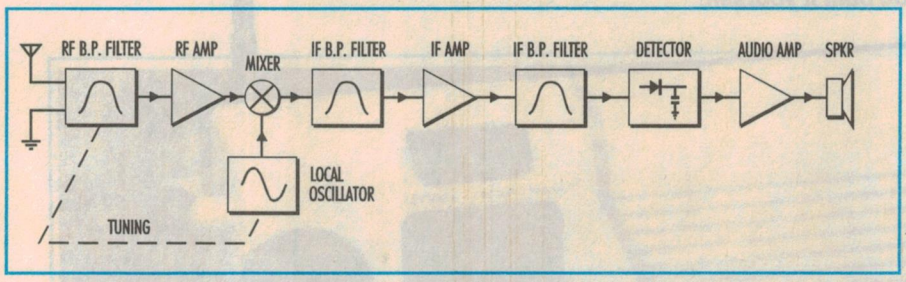


Fig.1: The block diagram for a basic superhet radio receiver.

proach is simply a contraction of *supersonic heterodyne'*, of course. Being still quite a mouthful, it later became shortened further to 'superhet'.

Early superhet receivers did actually have their IF filtering and amplification at a very low 'supersonic' frequency, below 50kHz. But as better valves and later devices like transistors and ICs came along, superhet IF's rose somewhat higher. For quite a few years now they've been standardised at 455kHz for AM radio receivers, and 10.7MHz in the case of FM receivers. (Even TV receivers use the same superhet principle, and in their case the IF is generally around 36MHz.)

Fig.1 shows the block diagram for a basic AM superhet receiver. As you can see, the signals picked up by the antenna system pass first through a tuned RF bandpass (BP) filter, and then through an RF amplifier (although this is often omitted in simple superhet receivers). Then they pass to the mixer, where they beat with the signal from the local oscillator, which is tuned so that its frequency is a fixed 455kHz (10.7MHz for FM) away from the wanted signals (usually, it's *higher*).

This means that the mixer produces a fixed 'difference' signal of 455kHz, and this IF signal (which carries the same modulation as the incoming RF signal) is then passed through bandpass filters and an amplifier. The final steps are to detect it, amplify the resulting audio and feed it to the speaker.

Hopefully with this basic idea of a superhet receiver under your belt, you'll now be in a better position to understand the circuit of this build-it-yourself radio.

The actual circuit of the radio is not very complicated, but you might still find it a little hard to follow — because it's actually *two* receivers rolled into one: an AM receiver using an IF of 455kHz, and an FM receiver with an IF of 10.7MHz. These not only share a common audio amplifier section, but in fact ALL of the amplifying and other 'active' circuitry for both receivers is crammed into a single 30-pin LSI (large-scale integrated) chip — the Sony CXA1019S.

The Sony chip

The circuitry inside the CXA1019S chip itself is shown in Fig.2. As you can see, it contains some seven different internal 'blocks' each of which performs a particular function.

On the right is the audio power amplifier block, which takes low-level audio signals from either the AM or FM detector (fed into it via pin 25), and amplifies them so that they are strong enough to drive a speaker (connected from pin 28 to ground). The only other pins connected with this section are pin 4, which can be used for negative feedback to set the amplifier's gain, and pin 5 — which can be used to feed in a varying DC voltage, to control the speaker volume.

Most of the remaining blocks on the chip are used for either AM or FM reception only, although some of them share pin connections.

For example the 'AM front end' block, which in effect combines the RF amplifier, mixer and local oscillator sections used for AM reception, has its input at pin 11 and its IF output at pin 15. Pin 6 is used to connect the tuning circuit for its local oscillator.

The corresponding 'FM front end' block, which again combines an RF stage, mixer and local oscillator, has its input at pin 14 and oscillator tuning connection at pin 8. A varicap (variable capacitance) diode inside the chip is also provided at pin 7, for use in providing the FM local oscillator with AFC (automatic frequency control) — so it stays tuned to the desired station.

The IF output from the FM front end is also brought out to pin 15 — the same pin used for IF output from the AM front end. So pin 15 delivers the 455kHz AM IF signal when the AM front end is operating, and the 10.7MHz FM IF signal when the FM front end is operating. (Only one of them is operating at any particular time.)

Next, the 'AM IF/DET/AGC' block performs all of the IF amplification and detection for AM reception (plus AGC or automatic gain control, used to balance out differences between the signals from strong and weak stations). The 455kHz IF input signal for this block is fed in via pin 17, and the resulting audio fed out via pin 24.

The two blocks marked 'FM IF' and 'FM discriminator' perform the corresponding functions for FM reception ('discriminator' is another name for an FM detector), with the 10.7MHz IF signal fed in via pin 18, pin 3 used to connect a tuned circuit for the discriminator, and the resulting audio coming out via pin 24. So again pin 24 is shared by both the AM and FM parts of the chip,

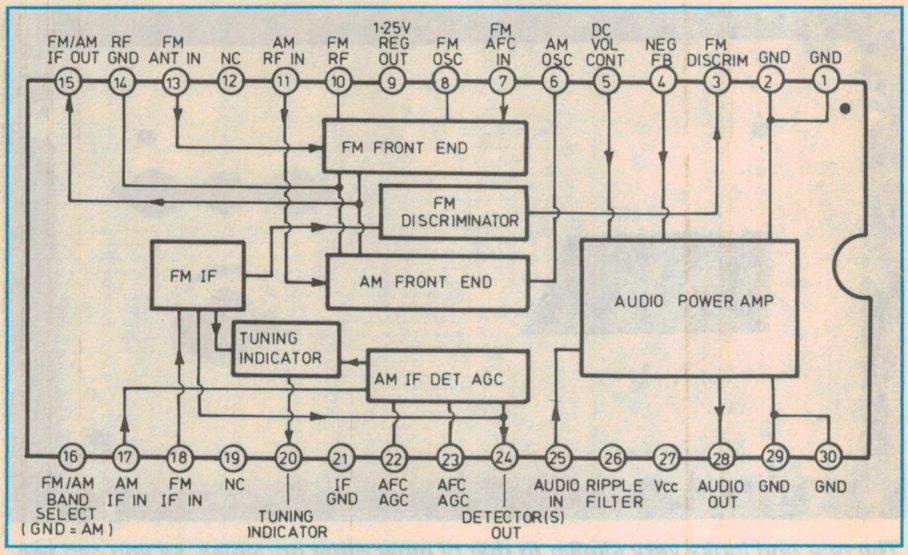
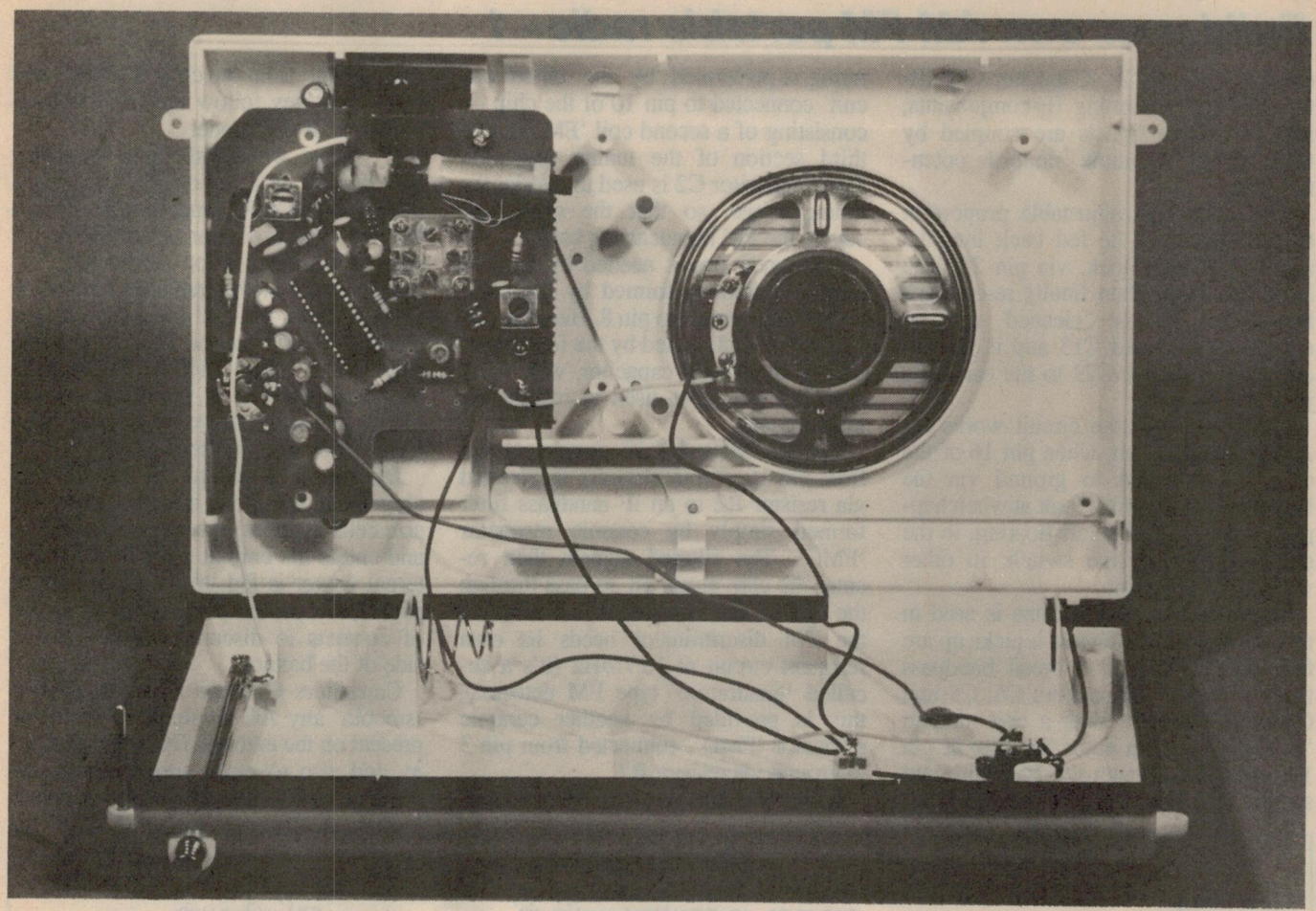


Fig.2: What's inside the Sony CXA-1019S chip, which forms the heart of our radio project. It's a fairly complex little beast — a complete AM/FM receiver chip.



A view inside the completed radio. In the second of these articles, coming next month, we'll show you how to put it all together — in easy stages. We'll also explain how to align it for correct operation.

delivering the detected audio signal in either mode of reception.

What determines the receiving mode — whether the AM or FM parts of the chip are working? This is done by internal switching, controlled simply by the external connection to pin 16 — marked 'AM/FM band select'. If this pin is connected to ground, the AM sections of the chip operate; on the other hand if the pin is left 'floating', the FM sections operate instead. So a simple switch between pin 16 and ground can be used for AM/FM band switching.

The remaining block inside the chip is marked 'Tuning Indicator', as you can see. This takes signals from either the AM IF/DET/AGC block or the FM IF AMP block, and is able to draw an output current into pin 20 which is proportional to the strength of the signals being received (i.e., the stronger the signal, the higher the current). As a result, pin 20 can be used for things like driving a tuning LED or meter, or controlling the audio output level for 'muting' between stations.

Finally, pin 9 of the chip provides a fixed and stable voltage of 1.25V DC, from an internal regulator circuit. This is used to provide stable biasing of many of the chip's signal inputs, as we'll see shortly.

The complete circuit

Now let's look at the way this 'AM/FM receiver chip' is actually used as the basis for our complete radio. As you can see from the main schematic of Fig.3, this mainly involves connecting it up to a collection of coils and other components, which do the filtering jobs shown in Fig.1.

First of all, we'll consider the bits that work for AM reception.

Like most portable AM radios nowadays, this set uses a ferrite rod or 'loopstick' antenna to pick up the AM signals.

This is a coil of wire wound around a short rod of magnetic ceramic material, and when the coil is combined with a tuning capacitor, it functions as both an antenna and a tuned circuit. The coil is shown on the schematic marked 'AM RF', and as you can see one section of the radio's four-section tuning capacitor is connected across it for initial selection of the wanted AM station's signals.

The selected RF signals are fed into pin 11 of the chip, as you'd expect from Fig.2. The 'other end' of the antenna is effectively connected to ground as far as RF signals are concerned, via bypass capacitors C8 (10nF) and C20 (10uF).

The AM local oscillator tuned circuit, connected to pin 6 of the chip, is formed by the coil marked 'AM OSC' together with a second section of the tuning capacitor — in series with fixed capacitor C7. This fixed capacitor is used as a 'padder', to ensure that the chip's local oscillator tunes to a frequency 455kHz higher than that of the antenna circuit.

The 455kHz IF output from the AM front end emerges from pin 15 of the chip, and is fed through resistor R3 to an IF bandpass filter formed by transformer IFY (AM IFT) with its inbuilt fixed tuning capacitor, feeding a 455kHz ceramic resonator 'AMC'. The resulting filtered AM IF signals are then fed back into the chip at pin 17, to pass through the AM IF/DET/AGC block.

After detection, the final audio signals

emerge from pin 24. Capacitor C10 filters out any remaining IF components, and the audio signals are coupled by C14 to the volume control potentiometer.

This allows an adjustable proportion of the signals to be fed back into the audio amplifier block, via pin 25. The amplified audio then finally re-emerges from pin 28, is 'cleaned up' by capacitors C12 and C13 and is fed via coupling capacitor C22 to the earphone jack and speaker.

That's the way the circuit works for AM reception, then, when pin 16 of the chip is connected to ground via the bandswitch. Now let's look at when happens when pin 16 is left floating, in the other position of the switch: in other words, FM reception.

The telescopic rod antenna is used in this mode, and the signals it picks up are first passed through a broad bandpass filter formed by capacitors C4, C5 and C6 in conjunction with a coil marked 'FM3'. They then enter the chip at pin 13, and pass through the FM front end section. Further tuned RF bandpass filtering is performed by the tuned circuit connected to pin 10 of the chip — consisting of a second coil 'FM3' and a third section of the tuning capacitor. Fixed capacitor C2 is used to restrict the tuning range, so that the radio just covers the FM broadcasting band.

The tuned circuit needed by the FM local oscillator is formed by the components connected to pin 8. Here the coil 'FM2' is mainly tuned by the fourth section of the tuning capacitor, with fixed capacitor C3 again used to restrict the tuning range.

The 10.7MHz FM IF signals emerge from pin 15, and in this case they're fed via resistor R2 to an IF bandpass filter formed simply by ceramic resonator 'FMC'. The filtered signals then re-enter the chip at pin 18, to pass through the FM IF and discriminator blocks. As the FM discriminator needs its own resonant circuit at 10.7MHz (it's a so-called 'quadrature' type FM detector), this is provided by another ceramic resonator 'FMD', connected from pin 3 to ground via resistor R7.

As before, the detected FM audio signals emerge from the chip at pin 24, and from here they follow the same path as the audio in AM mode.

If you've wondered about capacitor C1, this is used to couple the chip's varicap diode AFC capacitor (pin 7) into the FM local oscillator tuned circuit. To vary its capacitance for correct AFC action, it is fed with a suitable correction voltage from pin 22 of the chip, via resistor R5. Capacitor C16 is used to filter out any 10.7MHz signals present at pin 22, to provide a 'clean' DC correction voltage. (C18 also performs some of this filtering.)

DC power is fed to the CXA1019S chip from the 4.5V battery (three 'C' size cells in series) via the on/off switch, and enters the chip at pin 27. When external power is fed in via the DC input socket, the power plug operates a pair of contacts to disconnect the negative side of the battery.

Capacitors C11 and C21 are used to 'smooth' any AC ripple which may be present on the external DC when it is fed in, and also to make sure that the impedance from pin 27 of the chip to

PARTS LIST

Main items

Printed circuit board (PCB), coded ME-889
Plastic case (two halves)
Speaker, 75mm OD
Integrated circuit (IC), Sony CXA 1019S
Volume control switch/pot (50k)
Tuning capacitor, miniature four section
Band switch, DPDT slider (PCB mount)
AM antenna rod, ferrite (54 x 12.5 x 4.5mm)
FM antenna: telescopic metal rod

Coils & ceramic resonators

AM oscillator coil, in can (red slug)
AM IF transformer, in can (yellow slug)
AM antenna coil, on former 30mm long
FM RF coils (2), 3.5 turns (green)
FM OSC coil (1), 2.5 turns (gold)
AM 455kHz filter, marked 'U455Y'
FM 10.7MHz filter, marked 'E10.7A'
FM 10.7MHz discriminator resonator, blue with red dot

Resistors

R1	820 ohms (grey-red-brown)
R2	330 ohms (orange-orange-brown)
R3,4	2.2k (two, both red-red-red)
R5,6	100k (two, both brown-black-yellow)
R7	150 ohms (brown-green-brown)

Capacitors

C1	3pF ceramic
C2	22pF ceramic
C3	27pF ceramic
C4,5,6	30pF ceramic (3)
C7	150pF ceramic
C8,9,10	10nF ceramic (3, marked '103')
C11,12,13	40nF ceramic (3, marked '403')
C14	0.1uF ceramic (marked '104')
C15	1uF/50VW electrolytic
C16,17	4.7uF/50VW electrolytic (2)
C18,19,20	10uF/50VW electrolytic (3)
C21,22	220uF/10VW electrolytic (2)

Hardware

Door for battery compartment, plastic
Locking knob for battery door, plastic
Washer, metal, for locking knob securing
Control knobs, plastic (2 x 29mm OD)
Slider knob for band switch, plastic
Band switch actuator bracket, plastic
Mounting bracket for ferrite rod, plastic
Carrying strap, woven plastic 20 x 900mm
Carrying strap attachment rods, metal (2 x 26mm)
Carrying strap buckles, plastic
Tuning dial pointer, plastic
Tuning dial scale
Tuning dial 'glass', plastic
Tuning drum, plastic (37mm OD)
Tuning knob shaft, with bush and nut.
Pulley for dial cord, plastic (7mm OD)
Pulleys for dial cord, brass (2 x 7mm OD)
Fibre washers for cord pulleys (1 x 3mm ID, 2 x 2.5mm ID)
Dial cord, 500mm
Dial cord tension spring
Tuning capacitor shaft adaptor, plastic
Volume control shaft adaptor, plastic
Volume control knob adaptor, plastic
Earphone socket with nut
DC power input socket
Battery contact spring, conical
Battery contact plate
Solder lug for FM antenna rod connection
PCB connection eyelets (5 x 4mm x 2mm dia.)

Screws:

7 x 9mm self tapping (RH, pointed end)
5 x 9mm self tapping (RH, blunt end)
1 x 7mm self tapping (RH, wide head)
1 x 4.9mm x 1.6mm dia machine screw (RH)
1 x 4.8mm x 2.6mm dia machine screw (CH)
2 x 3.9mm x 2.5mm diam machine screw (CH)

Hookup wire:

70mm length, black
70mm length, yellow
100mm length, red
140mm length, blue
170mm length, yellow
170mm length, black
170mm length, white
225mm length, black
250mm length, red
40mm length, tinned copper wire

Sealing gaskets:

Main case gasket, rubber
Earphone/DC jack gasket, plastic
Battery compartment door gasket, rubber
Dial glass gasket, plastic
Screw hole plugs (5)
Cosmetic 'line' for case front (red)

Plastic foam washers:

Volume knob washer (23mm OD, 14mm ID)
Tuning knob washer (24mm OD, 9mm ID)
Band switch washer (24 x 10mm)
Battery door locking key washer (15mm OD, 9mm ID)
(2 x foam pieces for FM coils)

Stickers:

Name plate ('Mealstronic')
Rating label
Battery orientation label

Key: OD=outside diameter, ID=inside diameter, L=length, D=diameter, RH=round head, CH=countersink head.

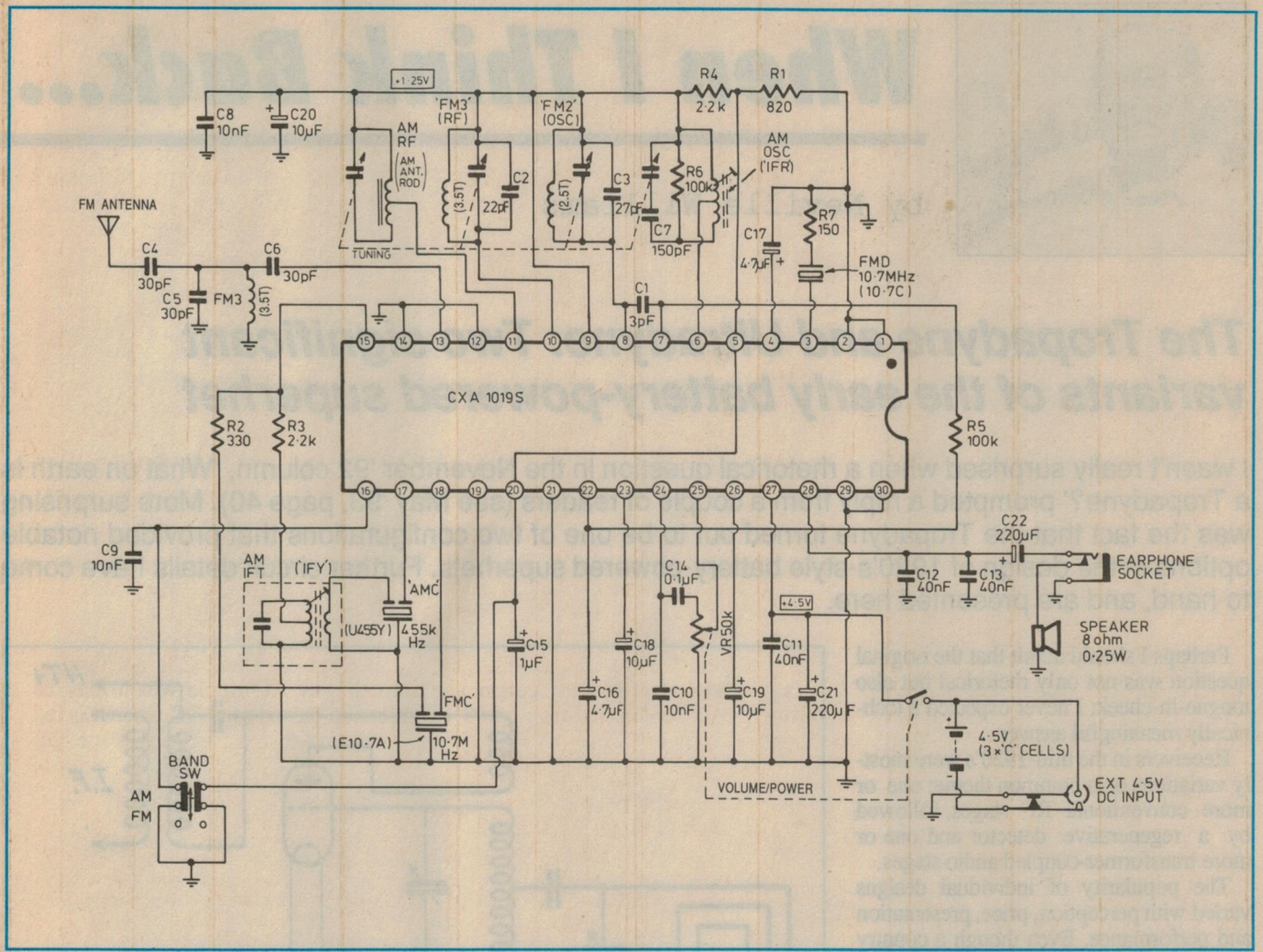


Fig.3: The complete schematic for our receiver. It offers all of the features found in most AM/FM portables — but the big advantage is that you can build it youself, and learn how they're made.

ground is low even when the battery cells are becoming discharged. Capacitor C9 is also used for internal supply filtering and decoupling, while capacitor C17 is used to bypass the audio amp's negative feedback input to ground, to achieve maximum gain.

The remaining parts of the circuit to be discussed are resistors R4 and R1, capacitor C15, the link between pins 5 and 20, and the second pole of the band switch. These are actually used to provide 'muting' between stations on the FM band, so that the receiver doesn't hiss loudly without a signal.

You might recall that pin 5 can be used to control the gain of the audio amplifier, by means of a DC voltage. We aren't using it for our main volume control here, but this leaves it free to be used for muting.

It turns out that maximum volume is achieved when pin 5 is pulled down to ground potential, while increasing the DC voltage at the pin causes the volume to be reduced. By connecting this pin to resistors R4 and R1, which form a voltage divider across the stable 1.25V supply (from pin 9), we supply it with a fixed DC voltage of about 0.35V — so that the volume level is reduced. This is the 'muted' condition.

The link between pins 5 and 20 allows the muting to be disabled, when a station is being received on the FM band. You may also remember that pin 20 is the 'tuning indicator' output, which draws current only when a signal is being received, and its current is proportional to signal strength. So when there's no signal, pin 20 draws no current and pin 5 still has the 0.35V muting voltage supplied to it.

But when a signal is tuned in, pin 20 draws current, and as a result pulls down the voltage on pin 5. So the volume rises, 'unmuting' the audio and allowing the station to be heard at normal volume.

Capacitor C15 is used to 'slow down' this muting and unmuting action, so it doesn't cause distortion in response to sudden changes in signal strength. As signal fading tends to make it difficult to achieve correct muting operation on the AM band, the muting circuit is simply disabled for AM reception by shorting pins 20 and 5 to ground, using the second pole of the band switch.

Well, hopefully by now you have a good idea of how the radio works. But we've run out of space this month, so building and aligning it will have to wait until next time.

In the meantime, you may like to purchase your kit, open it up carefully and check that you've been supplied with everything you're going to need.

Do this by checking everything off against the parts list. Take care not to lose any of the parts, though — some of them are very small. After you've checked that they're all there, it's a good idea to put the small parts in particular back inside the original plastic bags, so they can't stray.

See you next month, when we begin by explaining in easy to follow steps how the radio is put together. ❖

When I Think Back...

by Neville Williams

The Tropadyne and Ultradyne: Two significant variants of the early battery-powered superhet

I wasn't really surprised when a rhetorical question in the November '92 column, 'What on earth is a Tropadyne?' prompted a reply from a couple of readers (see May '93, page 40). More surprising was the fact that the Tropadyne turned out to be one of two configurations that provided notable options in the design of 1920's-style battery-powered superhets. Further circuit details have come to hand, and are presented here.

Perhaps I should admit that the original question was not only rhetorical but also tongue-in-cheek; I never expected a technically meaningful answer.

Receivers in the mid-1920's were mostly variations on a common theme: one or more conventional RF stages, followed by a regenerative detector and one or more transformer-coupled audio stages.

The popularity of individual designs varied with perception, price, presentation and performance. Even though a country schoolkid at the time, I recall two configurations that stood out from the above:

(1) The 'Neutrodyne', featuring neutralised (or stabilised) RF stages but otherwise conventional, and

(2) 'Superheterodynes', in which incoming signals were converted to a lower 'intermediate' frequency, at which exceptional gain and selectivity could be achieved.

Both configurations acquired a certain mystique, such that possession of either one — but *especially* a superheterodyne — set its owner apart from other 1920's-style enthusiasts.

Mystique notwithstanding, many designers/suppliers side-stepped both principles, possibly because of patent restraints and/or hesitation about adopting technology that might confuse vendors, customers and local 'experts' alike. However, to keep up appearances, some of them appear to have dreamed up names for otherwise conventional receivers, terminating in the magic syllable 'dyne'.

Reflecting on this, and motivated by sheer curiosity, I reached down my copy of Morgan McMahon's book *Vintage Radio — 1887-1929*, containing a list of receivers current in America during the period 1921-1930. I gave up part way through the 22-page alphabetical file but, as you will note from the accompanying panel, it includes quite an assortment of odd-sounding '-dynes', promoted in the years 1924-26.

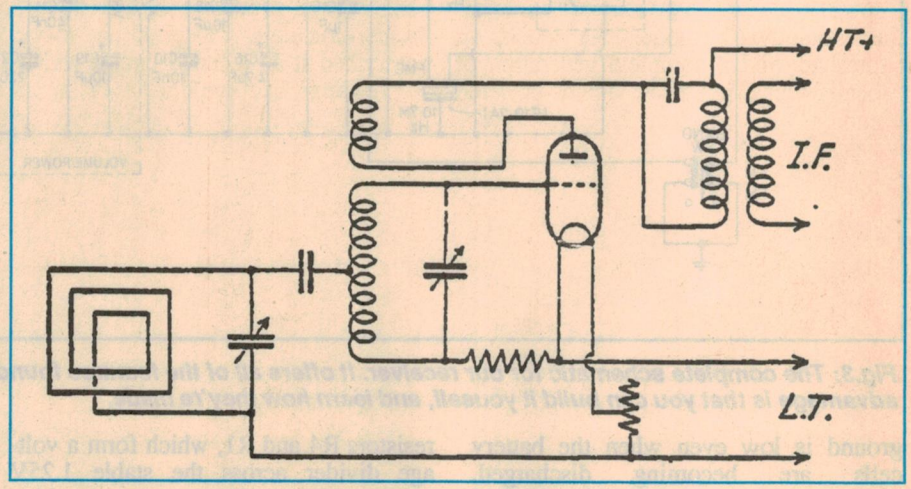


Fig.1: The frequency changer stage in a Tropadyne receiver, reprinted from our May 1993 issue. It was supplied to us, in the first instance, by Michael Eager of Brighton, Vic.

What's in a name?

From what I remember, such patently contrived names didn't cut much ice with the 'bush' wireless enthusiasts that I knew as a lad.

So it was that my initial 'gut' reaction to 'Tropadyne', 70 years on, was to dismiss it as just another meaningless term. According to my *Macquarie Dictionary*, 'troppo', as a colloquial adjective, could even signify a degree of mental unbalance! Of course had I studied the dictionary a little more closely, I would have noticed that 'tropo' (one p) is a word form denoting variation or change.

More to the point, in his *Practical Superhet Book* (Cassell & Co, London, undated) Editor Bernard E. Jones says:

The word Tropadyne is derived from the Greek tropia, to change, and dyne, denoting force; the term referring to a single valve acting both as detector and frequency changer.

(For photostats from the above book, I am indebted to Clem Scott, VK4DW, of Bundamba, Qld).

In short, and as you may recall from the May 1993 issue (pages 40 - 41), the Tropadyne — sometimes spelt tropodyne — turned out to be an interesting variant of the conventional superheterodyne.

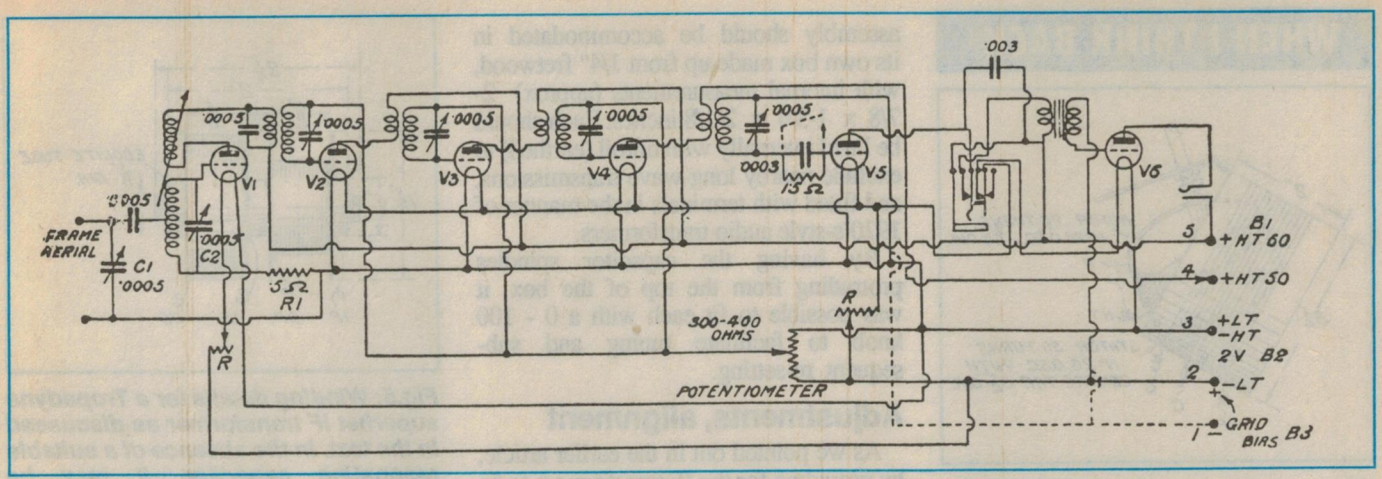


Fig.2: The complete circuit for a typical Tropadyne receiver described for home construction by Bernard E. Jones in 'The Practical Superhet Book' (Cassell & Co Ltd, London).

Whereas early battery-powered superhets required separate oscillator and mixer valves to effect the necessary frequency change, the Tropadyne managed to fill both roles with a single triode — operating in what later came to be known as 'autodyne' mode. As such, it foreshadowed a complete generation of locally mass-produced mains-powered autodyne superhets in the early 1930's, which ushered in Australia's 'Golden Age' of radio.

Unique 'front end'

Fig.1, reproduced from our May '93 issue, illustrates the basic principle of the Tropadyne frequency changer. Further to summarise the original text, the valve functioned as a variable self-excited oscillator by virtue of the tuned grid circuit and an associated anode feedback winding.

A tuned loop (or frame) antenna was connected between the LT supply ('earth') and, through a capacitor, to the mid point of the oscillator coil. Being the nodal point as far as the oscillatory voltage was concerned, very little oscillator signal could be diverted into the antenna circuit, thereby alleviating a radiation problem that bugged most other superhets of the day. Conversely, the top half of the oscillator coil offered a ready path to the grid for incoming signals selected by the tuned loop, thereby allowing heterodyne mixing to take place.

As a matter of interest, in an article on 'Non-Radiating Regenerative Detectors' (*Radio News*, USA, October 1924, p.496), Clyde Fitch pointed out that the Tropadyne input configuration could equally serve to block extraneous radiation from ordinary regenerative detectors which were allowed to oscillate, either inadvertently or deliberately — when copying CW Morse signals.

The same Clyde J. Fitch described a complete six-valve Tropadyne superhet in the August 1924 issue of *Radio News* (USA), made available to me, per photostats, by Don Sutherland of Wanganui in NZ. An accompanying advertisement for a constructional blueprint and booklet described it as a 'new' circuit which is 'spreading like wildfire'. It is also claimed to be 'the only receiver with tunable intermediate transformers'.

In a drop-in panel, the Editor commends the six-valve Tropadyne as equalling the performance of existing eight-valve superhets, because (a) it had obviated the need for a separate oscillator valve and (b) the tuned IF transformers were more efficient in terms of gain and selectivity than the usual 'unequalised' type.

On the subject of radiation, he says that the Tropadyne was virtually radiation-free, 'thereby not interfering with other receiving stations. Most superheterodyne circuits, as is well known, are powerful radiators'.

Consistent with this last statement, Fitch's Tropadyne included a normal tuneable input coil having 29 turns of 20-gauge ssc (single silk-covered) wire on a 3" former. A 20-turn primary spaced 1/2" from the earthy end provided for external antenna and earth connections. On the front panel, a switch/jack was so wired that plugging in a frame aerial substituted it for the coil.

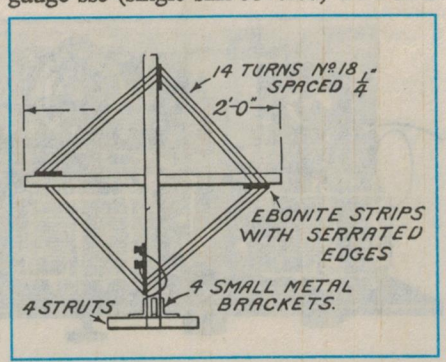


Fig.3: Details of a home-made loop (or frame) antenna. It could be used with receivers other than the Tropadyne.

British circuit

A similar receiver to the above was described for home construction by Bernard Jones in the *Practical Superhet Book*, mentioned earlier. Jones does not discuss the origin of his design, but my tip is that it was inspired by Fitch's article in *Radio News*.

Intended primarily for British experimenters, Jones' six-valve Tropadyne (shown in Fig.2) was marginally more compact than the *Radio News* design, calling for a baseboard measuring 23" x 7-3/4" and a panel of 24" x 7-1/8".

Despite the low oscillator radiation, Jones recommended routine use of a frame antenna (Fig.3) on the grounds that its inherent directivity could offer additional rejection of unwanted signals and noise interference. If the constructor opted instead for a conventional outdoor antenna and earth, he would have to provide a separate antenna coil, housed in a protective box external to the main receiver.

Curiously, Jones offered no guidance as to the choice of valves, beyond evidence from the illustrations that the prototype was fitted with general-purpose triodes with European four-pin bases. Cossor 'Wuncell' valves receive passing mention as one possible option — these were economical dull-emitter types introduced around 1924. (The Fitch version would normally have used the power-hungry American 201-A's.)

As indicated by the slanted arrow on the schematic, the oscillator coil was a variocoupler as shown in Fig.4, connec-

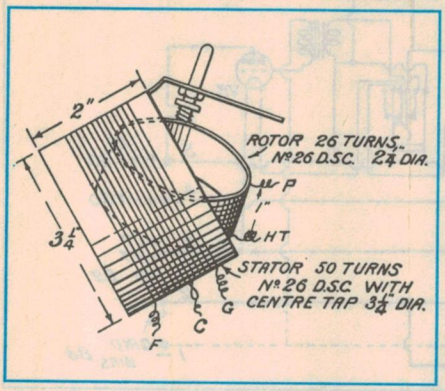


Fig.4: A hand-made variocoupler oscillator assembly by which the intensity of oscillation could be controlled by varying the inclination of the anode winding.

tions being so phased that the valve would oscillate most strongly with the coils set in parallel. Axial rotation of the inner coil would then progressively reduce the amplitude of oscillation, as also would a reduction in filament voltage by operating rheostat 'R'.

Incidentally, the grid return resistor R1 should read 0.5 megohm, rather than 0.5 ohm as shown.

IF transformers

The circuit calls for four IF (intermediate frequency) transformers. Referred to by Jones as 'high-frequency transformers', they could be home-constructed or purchased ready-made as 'Tropaformers'.

Home construction involved fabricating four ebonite cheeks for each transformer, and cementing them onto an ebonite tube so as to accommodate two bobbin windings as shown in Fig.5.

All four secondary windings required 1000 turns of 30-gauge ssc wire, preferably layer wound with thin wax paper between layers. The primary windings comprised 500 turns of the same wire, wound in the same direction.

Each transformer had to be fitted with an identical core, comprising thin silicon steel laminations measuring 1/2" by 2-1/4", stacked to a thickness of 1/4", wrapped to a push-fit inside the central tube.

The tuning capacitors shown in the circuit were 500pF mica dielectric types, small enough to fit inside the same housing as the windings and be internally connected across the secondary. Jones says that at 3000 to 7000 metres (100 to 43kHz), dielectric losses are not a problem.

He specifies that each IF transformer assembly should be accommodated in its own box made up from 1/4" fretwood, with internal measurements (approx) 2-7/8 x 1-3/4 x 2-1/8 inches. Each should be lined internally with tinfoil (earthed) to exclude nearby long-wave transmissions, and fitted with terminals in the manner of 1920's-style audio transformers.

By having the capacitor spindles protruding from the top of the box, it was possible to fit each with a 0 - 100 knob to facilitate tuning and subsequent re-setting.

Adjustments, alignment

As we pointed out in the earlier article, by providing for the IF transformers to be adjusted in situ to a selectable frequency, the Tropadyne evidenced much greater deliberation than the average superhet of the day — where the IF ended up at some unspecified frequency, by virtue of fitting somebody's 'matched set' of high frequency transformers.

As it is, those specified for the Tropadyne may provide a valuable reference for vintage radio enthusiasts wishing to recreate an old-time superhet.

The gain and stability of the IF channel depended on the setting of a 300 - 400 ohm potentiometer. Described at the time as a 'Stabiliser', its normal role was to vary the potential of the RF amplifier grids relative to the filament supply.

In this Tropadyne circuit, returning the IF amplifier grids to A-plus would impose a positive bias relative to the negative end of the filament. Grid current would flow, lowering the grid input impedance and reducing the 'Q' of the IF transformers. Any regenerative tendency would be reduced, thereby reducing the gain.

Rotating the control towards the other extreme would have the opposite effect, so that it could behave rather like a regeneration control.

If the Stabiliser could not cope with unduly strong local signals, the loop antenna could conceivably be deflected or detuned. But the Jones receiver offers a further option, possibly adapted from the Fitch circuit.

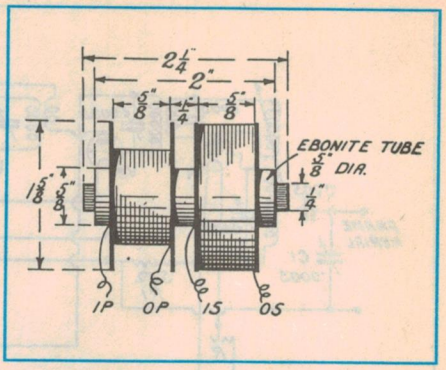


Fig.5: Winding details for a Tropadyne superhet IF transformer as discussed in the text. In the absence of a suitable resonating capacitor, it may be possible to contrive one from an old-style compression type mica 'padder'.

It caught my eye because of the dotted line above the detector grid components — a 300pF capacitor and what I am sure should be a 1.5 megohm resistor (not 1.5 ohms as shown).

If a listener found that the available signals in the area were unduly powerful, the option was to short out the grid components and return the grid circuit (as per the dotted line) to a suitable negative tapping on a 'C-' (bias) battery — typically -1.5V or more. This would change the detector from the traditional 'grid-leak' mode to 'anode bend', reducing its gain but increasing its ability to cope with high-level signals.

The dotted line also suggests the possibility of returning the grid of the output valve to a suitable negative bias, as in the Fitch receiver — a measure which would possibly reduce both distortion and battery drain.

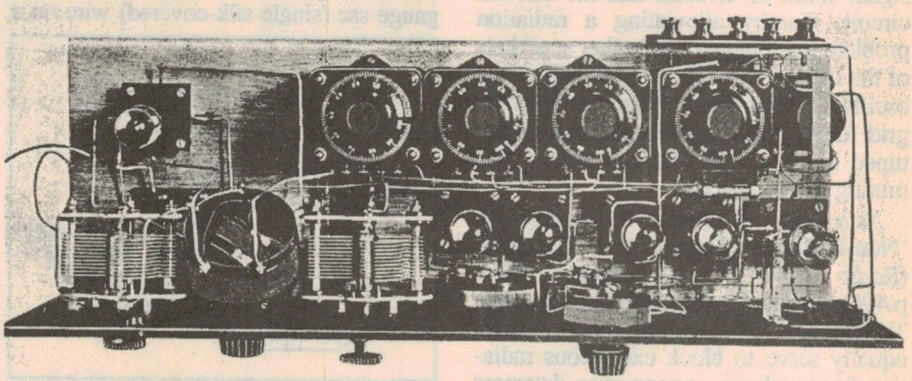


Fig.6: A plan view of Bernard E. Jones' Tropadyne. Note the variometer behind the front panel, between the two tuning capacitors, and the four IF transformers along the back, each surmounted by its own tuning knob.

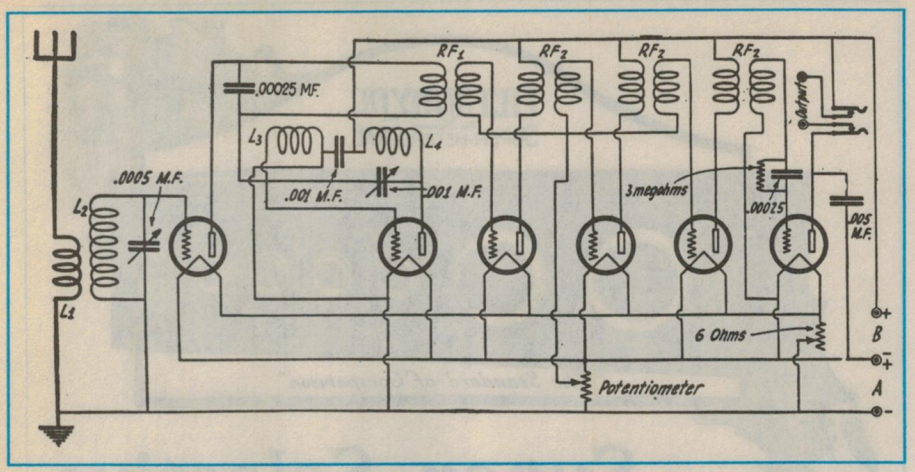


Fig.7: Circuit details of the Ultradyne receiver as described by Robert E. Lacault in the February 1924 issue of 'Radio News' (USA). No audio stages are included.

Whistles & squawks

Fig.6 gives a good idea of what Jones' home-made Tropadyne looked like. He assures his readers that the completed receiver is relatively easy to adjust, but I doubt that those accustomed to ordinary TRF sets of the day would have found it so. In brief, the reader is told to set the main potentiometer at mid position and all HF (IF) amplifier tuning capacitors at about 50°, whatever that means. The frame antenna should also be orientated edge-on to a direction from which signals might reasonably be expected to come. Then:

Set the oscillator coupler at about 20 degrees(?), set the oscillator tuning close to one extreme(?) and rotate the antenna tuning capacitor slowly through its full travel, listening carefully for a possible signal. If unsuccessful, advance the oscillator tuning by about 2 degrees and repeat the process.

A signal may ultimately be encountered accompanied by a 'slight squeak'. If so, turn the potentiometer slightly towards the positive end. When the squeak disappears, tune the signal for best results and try nudging the HF amplifier capacitors this way and that, beginning with the one following the mixer.

The objective is to peak the HF transformers for best results on the weakest audible signal, after which the HF capacitor settings can be left as is, and the settings recorded for future reference.

Meanwhile, persistent carrier squeaks or whistles may hopefully be corrected by adjusting the potentiometer, reducing the oscillator coupling by means of the variometer and/or reducing the value of the mixer grid leak R1.

The listener is advised to record the panel control settings for all stations as they are identified, but there is no mention of the fact that, with such a low IF, certain stations will appear at two quite different settings of the oscillator. Note would also need to be taken of the antenna orientation for individual stations.

One observation, however, left me completely at a loss:

A steady beat note in the receiver indicates a broken connection and this should be traced out and remedied!

In these days, with refined circuits, experience and instruments to hand, frequency conversion, oscillator grid current, circuit tracking, image reception and so on are no big deal. But they certainly would have been for listeners back in 1924, trying to make sense of contemporary superhets by interpreting whistles, squeaks and squawks!

'Come, dyne with us!'

To illustrate how many variations on names ending in '- dyne' were promoted by receiver manufacturers in the 1920's, here's an extract from a listing given in Morgan McMahon's book *Vintage Radio — 1887-1929*:

A.C.Dayton	'24 Super Polydyne
	'25 XL series Polydyne
Adams-Morgan	'25 Paradyne series
Atwater Kent	'23 Radiodyne
Blue Seak Mfg	'25 Cincodyne
Chelsea Radio	'25 Regenodyne series
Cleartone	'24 Clearodyne series
	'25 Super Clearodyne
Crosley Radio	'24 Trirdyn
De Witt	'25 Reactadyne
	'25 Super Reactadyne
Diva Radio	'24 Superdyne
Globe Electric	'24 Duodyne series
	'25 Duodyne series
	'26 Duodyne
Leutz Corp.	'24 Super Pliodyne
	'25 Universal Pliodyne
	'26 Imperial Pliodyne
Indiana Mfg	'25 Hyperdyne series
Kodel Mfg	'25 Logodyne series
Lytton Inc	'25 Way-O-Dyne
	'25 Super Way-O-Dyne
Magnus Elec	'24 Magnadyne
Metro Elec	'25 Metrodyne
Nassau	'25 Magnadyne

(.....and so on, through the alphabet)

Now, the Ultradyne

The Ultradyne is a further variation of the 1920's-style superhet, described by Robert E. Lacault AMIRE in the February 1924 issue of *Radio News* (USA), for which I am once again indebted to Don Sutherland of Wanganui, NZ. From the date, it would appear to be a near-contemporary of the Tropadyne.

The author R.E. Lacault is said to have spent four years in research work in the Radio Division of the French Signal Corps. As such, he might not have been far removed from where the superhet is claimed by some to have been conceived.

Lacault, it seems, was convinced that there was a more appropriate way to heterodyne two signals in a superhet, than by feeding them both to the grid of a detector/mixer. The incoming signal could be fed to the mixer grid while the oscillator could quite separately modulate the anode supply — an adaptation of what occurred in speech modulated transmitters of the day.

According to Lacault, the potential advantages were a higher modulated output

(increased mixer gain) and isolation of the oscillator signal from the grid circuit (decreased radiation). That Lacault attached considerable weight to the latter was evidenced by the fact that he strongly recommended the use of a conventional antenna and earth, even if only a wire strung around the room one foot from the walls and ceiling. Failing a proper earth, a counterpoise could be substituted — comprising a similar length of wire spread out under the carpet.

Fig.7 shows the schematic circuit of Lacault's Ultradyne, relying on what he called the 'modulation system' of frequency conversion. As shown, the incoming signal is fed directly to the grid of the mixer valve, without the usual coupling capacitor and resistor required by a 'cumulative grid' detector.

The anode connects, as normal, to the primary winding of the first IF transformer but is not fed from the B+ line. It returns, instead, to the grid of the local oscillator such that the mixer valve could conduct only during brief, positive-going peaks of oscillator signal. (No wonder they intermodulate!)

The second valve was/is manifestly the oscillator although, even after re-drawing it, I was still unsure as to whether the published diagram was as Lacault would have intended. However, his philosophy is clear enough as also is the fact that, unlike the Tropadyne, there was never any thought of doing without the oscillator valve. Valves three, four and five are general purpose triodes (e.g., 201-A's) serving as IF amplifiers with their bias controlled by a (typically) 400-ohm ('stabiliser') potentiometer.

All four IF 'Ultraformers' (RF1 etc) are wound as three 'pies' supported by non-metallic cheeks and washers, held together by a central bolt and mounting bracket. (Pictured in Fig.8). In each case, the secondaries comprise 1100 turns of 30-gauge dsc (double silk-covered) wire, comprising 550 turns in each of the outer slots, wound in the same direction and connected in series.

The primary of RF1 comprised 300 turns of 28g dsc wire wound into the centre slot and shunted elsewhere with a 250pF capacitor. In RF2, RF3 and RF4 the primaries, also wound in the centre slot, comprised 500 turns of 28g dsc wire.

Without shielding, iron cores and provision for external tuning, the ultraformers would have lacked the refinements of the tropaformers described earlier and, by inference, its potential gain and selectivity. Except for the 'unequalised' (untuned) ultra- formers, the setting-up routines would have been no less confusing than for the Tropadyne. Be that as it may, Lacault is lavish in his praise of the on-air performance of the Ultradyne, as judged on headphones in his New York apartment.

To operate a loudspeaker to advantage, he concedes that one or two audio stages would need to be added, plus extra battery power, bringing it up to the phyical proportions of conventional seven or eight-valve contemporary superhets.

To sum up, both designs reflect a considerable degree of initiative. But as '-dynes' go, and despite the enthusiastic backup by the Phenix Radio Corp, I'd have to rate the Fitch/Jones 'tropa' ahead of Lacault's 'ultra'! ❖

Fig.8: This advertisement from the April 1924 issue of 'Radio News' (USA) offered detailed constructional information for the Ultradyne, presumably modified to provide for audio amplification and loudspeaker operation.

THE SERVICEMAN

Hum loops, 'hot' surge protectors and problems that can humiliate...

This month we have three stories from contributors, and one of these comes from as far away as any item we have ever used in these pages: from Zaire, in Africa. It deals with some problems with a *very* familiar cause, though. The other writers provide interesting stories about having to fix your own test gear, getting a 'bite' from a mains surge protector, and trying to find the elusive cause of a mysterious black stripe on a CTV's picture. This last one turned out to another familiar and basic fault, too.

The story from Zaire comes from G.S., who lives in Bukavu. In his covering letter, G.S. says some nice things about this magazine, then comments that we are his sole means of keeping in touch with what's new in electronics.

It's nice to know that our efforts are found of value, in some places at least. It makes the hard yakka more tolerable to know that someone, somewhere, is making good use of our product. Anyway, let's get on with G.S.'s story:

I play serviceman for a number of expatriates living in a major town in Zaire. A large proportion of the jobs result from American 110-volt equipment being connected to the local 220-volt supply. My first story relates to a 'Ghetto Blaster' that fell foul of this hazard.

This particular model didn't have a fuse, and so the accident cooked the transformer primary. I realise that a fuse only protects against over-current, not over-voltage, but it is remarkable the number of times it is only the fuse that suffers.

When transformers get cooked out here, there are a number of alternatives I can offer the owner, depending on the circumstances. Sometimes we elect to write to the United States to get a replacement. That can take six to 10 months if delivered surface mail, or a great many dollars if delivered airmail.

Sometimes I manage to get the transformer rewound, or I might drop into one of the local 'servicemen' who seem to make a lot of their profits by selling parts from less needy jobs. This is what we elected to do for this machine.

Generally, if it is close enough to the same physical size, we manage to fit it in and adjust things accordingly. One advantage of this method is that we get a 220-volt primary, greatly reducing the risk of it falling foul to the wrong connection again.

In this particular case, all went well until I turned it on and measured 18 volts on the rail, instead of the required 12 volts. I quickly installed a trusty 7812 three-pin regulator, and this is where Murphy caught me out. Instead of hearing a nice clean sound, all I got was a loud squeal on top of massive hum, with a modicum of proper signal in the background. A quick check of the regulator confirmed a solid 12 volts at its output. I tried decoupling the rail with various values of capacitors, but all to no avail.

A check with the CRO revealed a high frequency oscillation riding on the proper signal, which in turn was riding on a strong mains hum. The latter made me suspect some sort of strange earth loop: but where? I tried removing the wire connection from the negative leg of the main smoothing cap to the centre earth pin of the 7812. A nice clean signal poured forth and all my problems were solved.

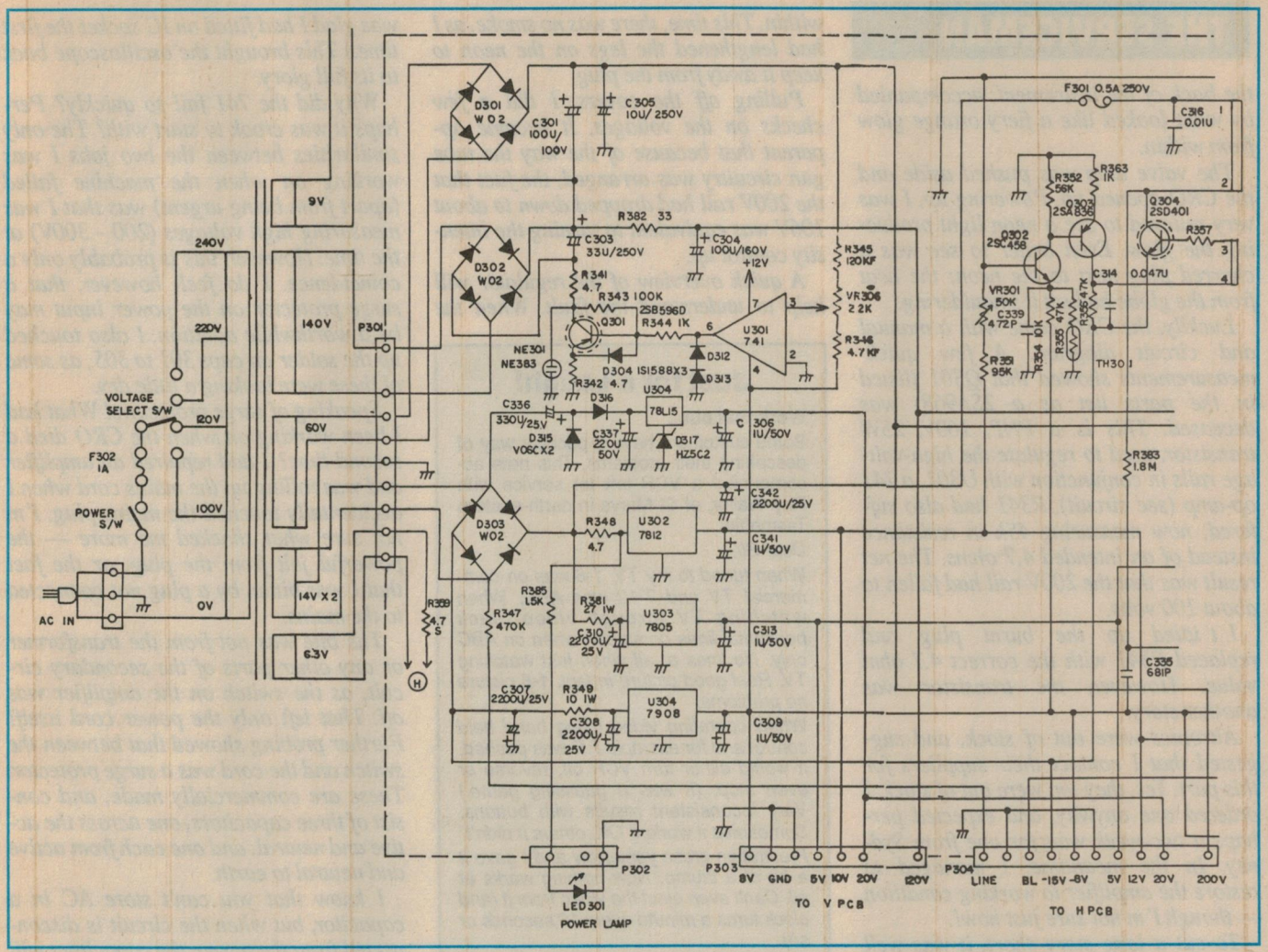
So why wasn't the earth really the earth? I had mounted the 7812 on a backing plate of the cassette deck, whose job I suspect was to shield any stray noise from the mains transformer mounted nearby. This backing plate had a flying lead earth secured to it with one of the mounting screws. I didn't bother isolating the 7812 since I considered all was at one earth or negative potential. But was it?

I was able to measure 6mV between the main cap and the backing plate. This was presumably the voltage drop involved in the 'daisy chain' earthing system, which just happened to have the backing plate at the end of the chain.

The next day I was chasing another squeal, this time emanating from a CB radio recently installed in our Land Cruiser. The squeal negated any necessity for a tachometer, as it very forcibly indicated the speed of the engine. I had checked all the normal causes of such noise and very carefully cleaned the area where the aerial is connected to the front cowling, and so ensured a good earth connection.

Being somewhat desperate, and having been caught out on an earth loop problem only the day before, I tried disconnecting the negative side of the power lead to the radio. (This set had both positive and negative power leads and did not rely on a chassis earth.) I expected that the coax braid would provide a suitable earth return, but surprisingly the whole set went dead.

With nothing to lose, I connected the



This extract from the schematic for a Labtech 20MHz CRO shows the power supply section which gave trouble for contributor L.M. The 200V line was dropping down to about 106V, which caused the instrument to display a bright, very blurry line which could not be manipulated using the intensity or focus controls.

negative power lead to the earthed sleeve of the PL259 coaxial connector, and that's all it needed. After securing the negative lead to the back plate on which the aerial connects, I was rewarded with squeaky clean silence — no matter how hard I revved the engine.

It seems that the back plate was mysteriously isolated from the rest of the metal case, and indeed from the negative rail. This meant that there was a small but significant voltage drop in the earth side of the coaxial aerial lead, thus causing all the problems.

While there are no major technical discoveries in these two stories, I hope that readers might be interested in these strange manifestations of the old earth loop problem. I hope that having these two pop up almost together is not an indication that Murphy has finally decided to live here on this great continent!

Well, thank you, G.S. I can agree with you that earth loops can be one of the most intractible troubles we can come across. The first problem is to recognise the fault for what it is — an earth loop. Then to do something about it.

I must admit that most of the earth loops that I've come across resulted only in hum in audio circuits. But as G.S. shows, they can also cause various screeches, whines and whistles that give rise to all kinds of mis-interpretations. Here's hoping that his story will alert readers to the many other kinds of earth loops that can exist in modern electronic equipment.

Fixing test gear

Next we come to a story from L.M., of Hope Valley in Western Australia. L.M. tells of one of the most frustrating repair jobs that any serviceman can be called on to perform — repairing his own test gear.

I know all about it since I used to repair my own multimeters, back in the days when such meters were too expensive to be replaced on any sort of regular basis. I've also worked inside the case of my oscilloscope, so I know well the frustrations that L.M. tells about.

Here's his story...

Probably the most frustrating thing when repairing customer's work is having to stop to fix your own instruments. I found this out twice recently, both times having to repair my Labtech CRO.

The offending oscilloscope is a dual trace 20MHz model, sold by Altronics, although I believe that it is also sold under other brand names. I must say that I am very pleased with its usual performance, but it took a turn for the worse last year.

While deeply entangled with a deceased valve guitar amplifier, the CRO decided to become a patient as well. I first noticed that a thick trace had appeared on what should have been a blank screen (I turn the intensity off when the CRO is not required).

Somewhat puzzled, I played with the intensity pot, but could not control the line. My efforts were rapidly brought to an end with a thin wisp of smoke from

the back of the instrument, accompanied by what looked like a fiery orange glow from within.

The valve amp was pushed aside and the CRO opened up. Powering up, I was very relieved to see a neon light producing the glow. Even better to see was a charred plug next to the neon; the heat from the globe had set it smouldering.

Luckily, the CRO came with a manual and circuit diagram. A few quick measurements showed that Q301 (listed in the parts list as a 2SA968) was deceased. This is a PNP, 160V, 25W transistor, used to regulate the high-voltage rails in conjunction with U301, a 741 op-amp (see circuit). R341 had also suffered, now measuring 45k in resistance instead of an intended 4.7 ohms. The net result was that the 200V rail had fallen to about 100 volts.

I t idied up the burnt plug and replaced R341 with the correct 4.7 ohm value. However, the transistor was another story.

Altronics were out of stock, and suggested that I contact their suppliers for this part. Yes, they too were out of stock. I ordered one anyway, and expected perhaps a two-week wait for one from Sydney. In the meantime, I managed to restore the amplifier to working condition — though I'm not sure just how!.

To cut a long story short, it was well over three months before I received the transistor. I had tried a number of places, but most were not interested in selling me just one transistor. (I'd have had better luck if I'd wanted a hundred, though.)

As I'm involved mainly in audio work, I didn't have many contacts in the TV industry where I believe these transistors are commonly used. I also wanted the exact part, not a TO-3 part that would have required several modifications.

Altronics, to their credit, were most helpful and I believe that eventually the parts were obtained direct from the manufacturers of the CRO.

I bought two transistors (a spare sounded like a good investment at this stage), which were actually 2SB861, with slightly higher ratings. Fitting involved removing 10 or so plugs on the power board (all tucked neatly in under the tube for 'easy' access). Eventually, the board was back, along with a new 741 op-amp, just to be on the safe side.

The instrument was back to as good as new — well, for now at least...

A few weeks later, with about 10 hours on the new parts, the big thick line was back, along with the fiery glow from within. This time, there was no smoke, as I had lengthened the legs on the neon to keep it away from the plug.

Pulling off the covers, I did a few checks on the voltages. It became apparent that because of the way the tube gun circuitry was arranged, the fact that the 200V rail had dropped down to about 106V was equivalent to turning the intensity control up.

A quick overview of the regulator will help to understand the fault. When the 200V rail drops, the comparator goes low, thus turning Q301 on. This pulls the negative side of C303 closer to ground (it would be negative otherwise), and hence the 120V rail rises.

This turns the op-amp and transistor off, and the cycle repeats. The 120V rail is thus regulated, as is the 200V rail, perched on top of it. The neon flashes on startup; I presume it 'catches' the voltage until the regulator is stabilised.

With the fault evident again, the 200V rail measured 106V and the 120V rail measured only 18V; the collector, base and emitter voltages of Q301 measured -147V, 0.74V and 0V respectively. Input pin 2 of the 741 measured -3.3V, while the voltage at the junction of C303 and R341 measured -150V.

I was now suspicious of the op-amp, as its output was high, despite having -3.3V on the input. I replaced this with a TL-071 that happened to be on hand. (I was glad I had fitted an IC socket the first time.) This brought the oscilloscope back to its full glory.

Why did the 741 fail so quickly? Perhaps it was crook to start with? The only similarities between the two jobs I was working on when the machine failed (apart from being urgent) was that I was measuring high voltages (200 - 300V) at the time. However, this is probably only a coincidence. I do feel, however, that a surge protector on the power input may be a worthwhile addition. I also touched up the solder on caps 301 to 305, as some of these were looking a little dry.

Speaking of surge protectors! What had I been working on when the CRO died a second time? I had repaired an amplifier and was rolling up the mains cord when I accidentally touched the mains plug. I'm not sure what shocked me more — the powerful jolt from the plug, or the fact that I was bitten by a plug not connected to the mains.

The bite was not from the transformer or any other parts of the secondary circuit, as the switch on the amplifier was off. That left only the power cord itself! Further probing showed that between the switch and the cord was a surge protector. These are commercially made, and consist of three capacitors, one across the active and neutral, and one each from active and neutral to earth.

I know that you can't store AC in a capacitor, but when the circuit is disconnected from the power, the capacitors will carry a charge equal to the voltage at the instant of disconnection. This voltage will persist until it is dissipated by leakage. Until then, it is free for you to feel.

This is what I was attempting to measure when the 'scope died. Before it did, I managed to find voltages well over 200V, which explained how I came to be bitten. Although the capacitors are not all that large (typically less than 0.1uF), they can still give an unpleasant shock.

To fix this, I would have preferred to place the filter after the main switch. This was not really practical, so I resorted to a 820k one watt resistor between the active and neutral. This gave a load for the capacitors to discharge into, rather than into me!

I don't know about you, but I really appreciate L.M.'s story. Most of the yarns that appear in these pages are about repairs to our customer's TVs and videos. It's not often that we get an informative yarn about our own test gear. Yet our test gear is as important to us as anything in the workshop.

Scopes and sig-gens, etc., are complicated pieces of electronic equipment. And although they don't break down all that

Just for a Laugh!

Work that out...

Some customers have a peculiar way of describing their problems. This note accompanied a VCR left for service with Ray Waller, of St Marys in north-eastern Tasmania:

Dear Sir,

When tuned to my TV, 1-6 was on commercial TV and 7-12 was ABC. When watching TV through video black horizontal lines on screen when on ABC only. No lines at all when just watching TV. Real good picture in fact. 1-6 picture no problems.

When operating video using hand held control and for example F.F. was pushed, it would either turn VCR off, reverse or even stop. (It was a guessing game.) Very inconsistent results with buttons. Sometimes it worked OK, others it didn't.

Frustration arose yesterday and I gave it a bit of a thump. Now nothing works at all. Can't even eject the video from it (and clock turns a minute every 10 seconds or so).

Other than those things, it works real good.

Regards...

OK, how would *you* go at solving that one?

often, when they do we are in no end of strife until they can be restored to full working order. There's no fun in having to return them to some central service depot, and self service like L.M. describes is a valuable contribution to our economic well-being.

I thoroughly agree with you about that surge filter, L.M. — it surely should have been fitted *after* the power switch. I can't imagine why anyone would design equipment otherwise. Still, having found the problem, you seem to have adopted a classical solution and that instrument should never bite another technician.

'Twilight zone'

Now for contributor number three. He is A.S., of Duncraig in Western Australia. As you will see, A.S. is an amateur serviceman and like so many of his kind, he found that dedication and long hours are no substitute for experience. The fault that gave him so much trouble for so long, finally yielded to five minutes work by a professional...

I'm telling his story here not to gloat, but so that our non-professional readers might learn a thing or two, and from that take heart that their own problems can be solved eventually — either by perseverance, or by seeking help from someone with more experience.

A.S. tells his story thus:

By profession, I am a medical researcher and lecturer, but I also do part-time consultancy work designing, building and servicing scientific and technical equipment. So when my seven- year old colour TV set decided to go out for lunch, I took this as a challenge and picked up the gauntlet.

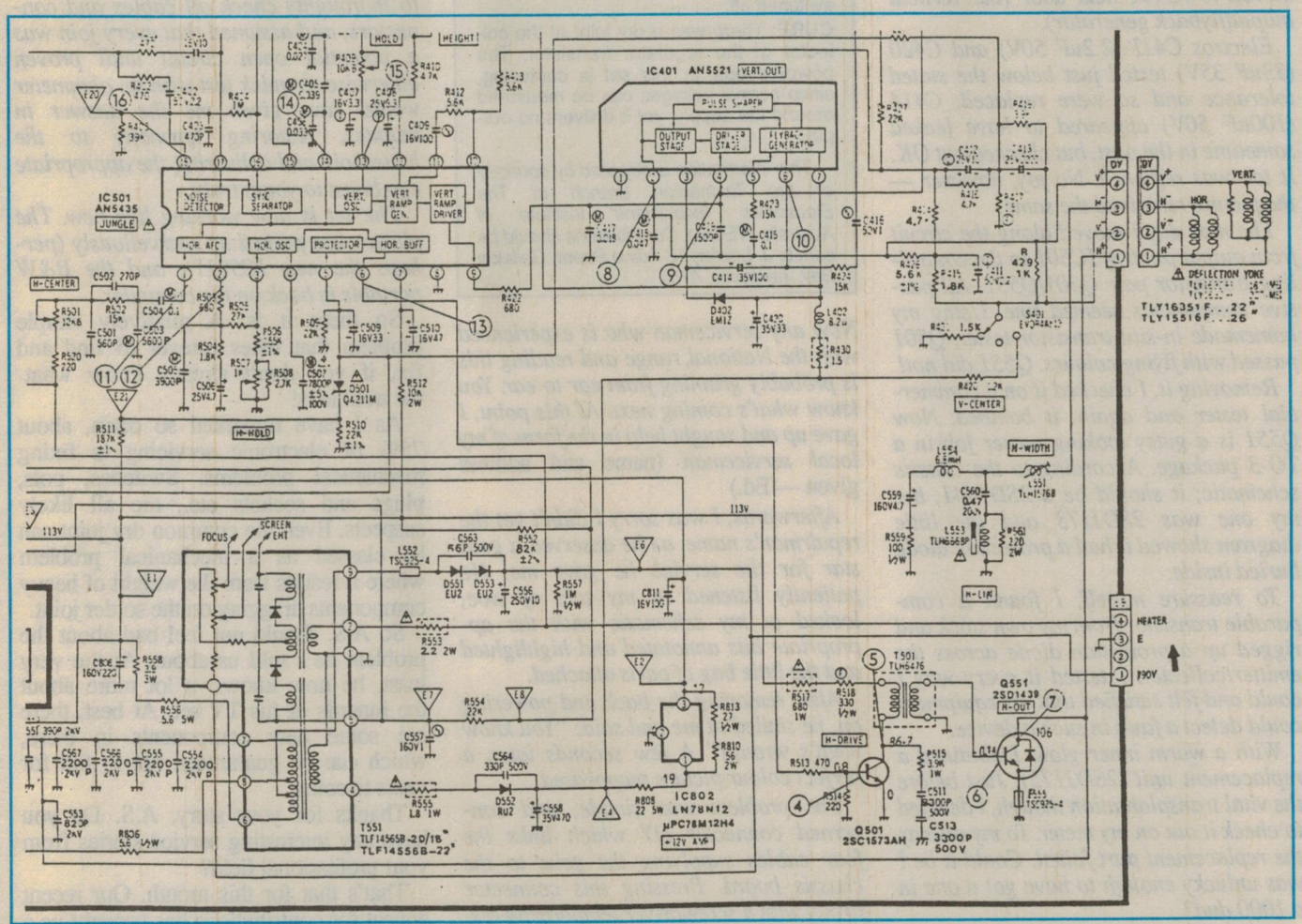
The set is a National TC-2657 (63cm) receiver, which uses a MB12B chassis. It has given years of flawless service until a few months ago. The problem was a slight loss of picture on the lower right corner of the screen, which originally was barely noticeable.

A black zone approximately 15mm in width and 100mm in length would gradually appear from the bottom of the screen, along the right hand edge of the picture during viewing. If the set was kept on for several hours, this area would lengthen and widen until it became very annoying. However, it could be corrected by switching the set off for a few seconds (muttering a few brief incantations under the breath) and then switching on again.

There was no change in the sound quality during all of this. This happy truce continued until three weeks ago, when the aberration (known in the family as the 'twilight zone') would not disappear with the usual remedy. Instead, what happened was a spectacular horizontal collapse of the picture.

The right hand quarter of the screen was blanked out, with the remaining picture now greatly distorted and in monochrome. It was time to dust off the old B&W portable, which had been hooked up to a computer.

A couple of days later, I began to tackle the problem. I reasoned intuitively that the fault was related to the horizontal portion of the deflection yoke. Examination of a schematic diagram for this set showed the horizontal coils were supplied by power transistor Q551.



The sweep circuitry of a National TC-2657 colour TV, which produced a strange black 'twilight zone' on the right-hand side of the picture. Contributor A.S. tried almost everything, without success — but the cause was surprisingly simple.

This was controlled from Q501 via transformer T501. The horizontal oscillator was generated in IC501 (a fairly standard AN 5435 chip).

After removing the back of the set and all the dead flies, silverfish, dust etc., a visual inspection did not reveal any clues. There was no evidence of loose plugs, arcing, scorching, leaky capacitors or the like.

A logical starting approach might have been to analyse the output of IC501 at pin 6. Access to a waveform generator and storage CRO was not a problem. However, the M12B chassis is 'live' and as most of my experience is with low voltage equipment, I wasn't going to risk frying a $3000 digital storage oscilloscope or indeed myself with this venture!

I began by checking the deflection coils — no problems here. Then I laboriously examined all the passive components surrounding IC501, paying particular attention to the electrolytic caps. A couple of hours later and with a very stiff neck I moved to IC401 next door (the vertical output/flyback generator).

Electros C411 (2.2uF 50V) and C420 (33uF 35V) tested just below the stated tolerance and so were replaced. C414 (100uF 50V) appeared to have leaked sometime in the past, but checked out OK. It too was replaced. No joy, however — the picture remained the same.

The next day I moved along the circuit from output pin 6 of IC501 to the controlling transistor pair Q501/Q551. All passive components seemed fine. Using my homemade in-situ transistor tester, Q501 passed with flying colours. Q551 did not!

Removing it, I checked it on a commercial tester and again, it bombed. Now Q551 is a gutsy looking power job in a TO-3 package. According to the chassis schematic, it should be a 2SD1441, but my one was 2SD1173 and the little diagram showed it had a protection diode buried inside.

To reassure myself, I found a comparable transistor from my own stock and rigged up a protection diode across the emitter/collector. I tested it every way I could and felt satisfied that my equipment could detect a fault in such a device.

With a warm inner glow, I obtained a replacement unit (2SD1175). Just before the vital transplantation though, I decided to check it out on my meter. To my dismay the replacement part failed. Could it be I was unlucky enough to have got a one in a 1000 dud?

Taking it back to the supplier, I explained my plight. The solution was simple. According to the manufacturer, these units cannot be tested using conventional transistor testers. The chap I spoke to explained that they often got customers returning these and similar units.

The best way is to measure the output with the power on or rig up a test circuit. To his credit, he managed to keep a straight face all the time! My warm inner glow was cooling fast. I replaced the unit and powered the set up.

Again, the picture was the same. What on earth was it? Perhaps the horizontal oscillator driver? After spending another hour slogging through all the theoretical possibilities, I ordered a replacement chip for IC501 (an AN5435). After several days waiting for the IC, I removed the incumbent and using a socket, installed the new one. Then, fingers crossed, I powered up and — NOTHING!

There was no change in the picture.

Fault of the Month

Philips CTV (KT2A-2 chassis)

SYMPTOM: Intermittent startup. Customer blamed the power switch, because once it started, the set would be OK until switched off.

CURE: There was a dry joint at the collector of the regulator transistor. The power supply in this set is confusing, since normal voltages can be measured around the supply, yet it delivers no output.

This information is supplied by courtesy of the Tasmanian Branch of The Electronics Technicians' Institute of Australia (TETIA). Contributions should be sent to J. Lawler, 16 Adina Street, Geilston Bay, Tasmania 7015.

Now any serviceman who is experienced with the National range and reading this is probably grinning from ear to ear. You know what's coming next. At this point, I gave up and sought help in the form of my local serviceman (name and address given — Ed.)

Afterwards, I was sorry I didn't get the repairman's name, as he deserved a gold star for the service he gave me. He patiently listened to my tale of woe, looked at my schematic with the appropriate bits annotated and highlighted and the little bag of parts attached.

After removing the back and powering on, he smiled at me and said: "You know what's wrong?" A few seconds later, a perfect colour picture reappeared.

The problem was simple, and concerned connector DY which links the four cables supplying the yoke to the chassis board. Pressing this connector firmly with a screwdriver temporarily restored the picture.

The pins and sockets of DY were made from a material that oxidised easily, producing a nice coating that slowly increased the resistance producing my black zone. Switching off and then on again gave a current surge that arced across the oxidation, decreasing the resistance thus restoring normality temporarily.

Apparently, these connectors usually failed while the sets were under still warranty. It was most unusual and unfortunate to get one to last over seven years before symptoms struck.

The remedy was as simple as the problem — hard wire the yoke supply directly to the underneath of the chassis board.

Now the hard luck angle of this story is that I must have had that connector apart four or five times during my investigations, but of course always with the power off. So not only did I miss any temporary improvement, I was unlucky enough not to dislodge enough oxidation to restore the circuit, so that when I did power on there was no improvement.

The 'take home message' from all of this was that I overlooked the basics. I was so keen to master the theory, I forgot to thoroughly check all cables and connectors, and assumed that every join was a potential open circuit until proven otherwise. A quick test with an ohmmeter would have given me the answer in minutes, restoring harmony to the household and delivering the appropriate ego boost to yours truly.

The set is now working like new. The picture has perked up marvellously (perhaps the new IC501?), and the B&W portable is back on the computer.

So there it is. A relatively simple problem that takes forever to find and fix, if you don't already know what the trouble is!

As I have remarked so often, about 75% of electronic servicing is fixing mechanical problems. Switches, pots, plugs and sockets etc., are all likely suspects. Even the common dry joint can be classed as a mechanical problem where it results from the weight of heavy components dragging on the solder joint.

So A.S. should not feel bad about the problem he's told us about. At the very least, he now knows a lot more about the innards of his TV set. At best, there are some new components in there, which can be guaranteed not to fail for years to come.

Thanks for your story, A.S. Do you have any interesting service stories from your professional field?

That's that for this month. Our recent appeal for contributions has brought us a small flood, so we'll have more reader's stories for you next month. TTFN! ❖

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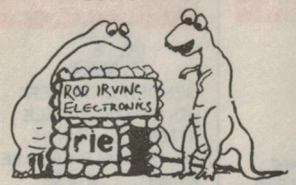

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Laminate those precious photo's & membership cards! ONLY.....$89.95

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3½" DS/HD FORMATTED AND PRETESTED WITH SOFTWARE FOR DATA INTEGRETY AND RELIABILITY

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9 Pin Printer With Paper Park ONLY.....$219.00

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Epsons new ink jet technology delivers crisp 360 x 360 dpi text and graphics

*48-nozzle Ink jet dot matrix

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*9 standard fonts

*Parallel port standard

*100 sheet paper cassette

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24 pin printer 200cps. d.s.

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24 pin printer 252cps. d.s.

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LQ-1070	24pin	252cps	136col.	$795
LQ-1170	24pin	350cps	136col.	$1149

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PROTECT YOUR COMPUTER WITH A FLOPPY LOCK.

Privacy of documents and personal or company data is very important in todays workplace. Particularly in today's business environment where being one step in front of the opposition is vital for success. Well now there is a simple and effective way to prevent prying eyes from seeing whats on your floppy disks while your not there. It's called a "Floppy Lock". It's made in the shape of a floppy disk which you simply insert into your floppy drive and turn a key to lock it into place, thus disabling the floppy drive.
It's also ideal for keeping the kids out of your computer!
The Floppy drive comes in both3 1/2" and 5 1/4" sizes.
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The more CD's are out of there protective covers the more risk there is of damage through dust and scratches.
Avoid damaging your CD ROMS by always storeing them in these Caddies that slide straight into your CD ROM.
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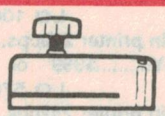

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Converts a 5 1/4" single sided floppy to a double sided floppy by placing an appropriate notch in the floppy disk jacket.
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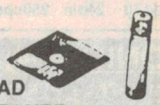

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It takes only a minute amount of dust, dirt or magnetic oxide particals on your drive heads to cause problems, errors downtime or an expensive service call. Regular use of a head cleaner will keep your drive free of trouble causing dirt.
it's simple to use & includes cleaning solution & instructions.
3 1/2" C12560..... $4.95
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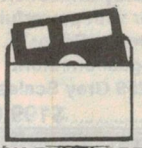

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Protect your 5.25" diskswith these disk envelopes Qty 25
C21020.....$1.95

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DISK LABLES
(To fit 3.5" disks)
Quantity 25 per pack
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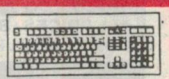
To fit all 5.25" disks
Quantity 25 lables and 25 write protects
C21021.....$2.95

KEYBOARDS & ACCESORIES



IBM COMPATIBLE EXTENDED KEYBOARD
X12022.....$45.00

101 KEY TRACKBALL KEYBOARD
Keyboard and mouse in one
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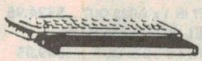
C21083.....$84.95



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C21093.....$9.95

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Prevent your eyes from damages.
- Minimize glare and reflection
- Easy installation

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X99991 15" Colour.....$59.95
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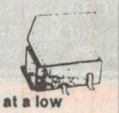

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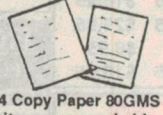

A-4 Copy Paper 80GMS white recommended for high speed copiers/Laser printer. Also available in recyclcled paper
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Z-NIX BUS MOUSE
Great for saving a serial port. 2 Free telepaint disks.Save $30 ONLY
X19951.....$89.00

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Keep your computer and accessories free form dust and grime while not in use.
- All covers are in clear plastic.
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C21067.....$12.95
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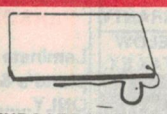

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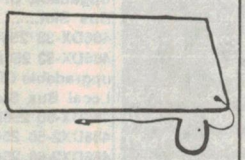
Wipe clean static electricity . Each mat includes a coiled alligator clip. Decreases friction. Accomodates the whole keyboard.
11.5" x 22".....$19.95



PC, PRINTER & KEYBOARD MAT
23.5" X 23.5"
Accomodates the whole PC, priter and keyboard.
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DB25 BACK BRACKET
1 HOLE
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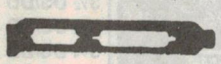

DB9 & DB25 CUT OUT
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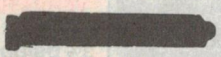

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P10909.....$1.95

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2 Universal brackets with screws to mount 3.5" hard drives into computer cases **X19971....$9.95**

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HD-15P MALE-MALE
X15690.....$14.95
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S: STRAIGHT TYPE
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MINI DIN JENDER CHANGER
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MINI DIN 6F/6F
X15686.....$12.95
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X15684.....$12.95
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X15673.....$14.95
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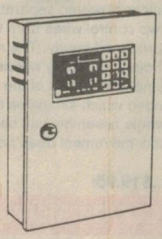
IBM MONITOR/ KEYBOARD ADAPTOR
DB-9P-DIN TO 5P DIN 5P
LENGTH 15CM
P39591 ..$14.95

THIS IS JUST A SMALL SAMPLE OF THE GENDER CHANGERS WE HAVE IN STOCK!

FOUR SECTOR ALARM PANEL



Alarm control panel for residential and commercial use with programmable four key digital keypad for arming and disarming. It utilises four independent isolatable protection circuits all with end of line resistor monitoring and all accept both normally open and closed switches.

General Characteristics

- Alarm is operated by numerical keypad on front of panel.
- Additional remote keypads can be added to the system.
- Built in test and mains / override power switch for servicing etc.
- Power: 16-18VAC power pack (not supplied)
- Built in recharging backup battery trickle charge circuit.
- Cabinet lock cam prevents unauthorised entry.
- Dimensions: 258(H) x 1702(W) x 74(D)mm

Four protection circuits

- One N.O instant circuit for 24 hr fire and panic protection
- One N.C. instant circuit for perimeter protection
- One N.C. delayed circuit for interior protection
- One N.O. delayed circuit for interior protection.

Intelligent Siren Driver.

- Accepts up to two 10 watt 8 ohm sirens.
- Sirens are continuously monitored to prevent tampering.

Independent Relay Outputs:

- Timing relay output and latching relay output

Auxiliary Outputs

- 12VDC - continuous output for passive infra red detectors etc.
- 12VDC - switch output for other sensors.
- LED warning Indicators:
- Exit/armed
- Instant circuit status
- Delayed circuit status
- Alarm memory
- Low battery indicator
- AC power

Audible Status Indicators

S14600.....$253.95

COME IN & HAVE A LOOK AT OUR LARGE RANGE OF ALARMS, SIRENS, DETECTORS & SECURITY ACCESSORIES FOR HOME & COMMERCIAL USE.

SOLAR THERMOMETER

Is it hot in here or is it just me? How many times have you wondered that? Well now you can get the answer with this solar powered thermometer. Place it on your desk or attach it to the wall. The solar thermometer is powered by electricity produced by two sets of built in solar cell.

When the solar cells are expose to light, it converts luminous energy into electrical energy, eliminating the need for batteries. Luminous must be 80 LX or more to activate the solar cells. The solar cells are set into a barrel that can be rotated to suit the source of lighting.

The Solar Thermometer can measure indoor and outdoor temperature at the flick of a switch. By placing the external sensor outside a window you will know whether to wear your winter woolies or strip down to your "speedos" without getting a rude shock. And for people who still think they are living the fifties or who just flew in from the States, the solar Thermometer displays the temperature in Fahrenheit as well as Celsius.

Z19071.....$39.95

DIGITAL THERMOMETER

Never again will you have to press your nose up to a thermometer to read what temperature it is. With this great digital thermometer the temperature can be read quickly and easily. It will read the temperature indoors and outdoors at the flick of a switch. By placing the thermometer's sensor outside, eg. hanging out a window, the thermometer will read outdoor temperatures -20°C to +70°C. Then by pushing the switch to the "IN" position the thermometer will read indoor temperatures of 0°C to +50°C.

A91200.....$24.95

Celsius & Fahrenheit

(note Celsius Fahrenheit thermometer has a smaller digital display.

A91201
Celsius Only.
.....$22.95

ELECTRET MIC INSERT

MINI MIC INSERT

Omnidirectioinal mini mic insert. 6mm diameter. (Ultra small)

- Operating Voltage: 1.5 to 15V DC
- Current Consumption: 0.5mA or less With a 9 volt supply
- Frequency Range: 40-12 000hZ
- Output Impedance: Same as load resistance (150 ohm-5k0hm)
- Sensitivity: 66dB+3dB
- S/N Ratio: More than 40dB
- Size: 7mm x 6mm dia.

Cat No. C10165

1-9	10+	100+	1000+
$2.00	$1.80	$1.70	$1.50

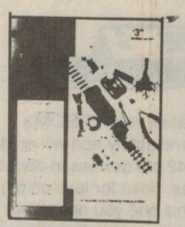
MIC INSERT with pins

Great replacement electret mic inserts for cassette or tape recorders, hobby projects, OEM projects and manufacturing. Operates from a single 1.5V battery. 10mm diameter, 10mm high. 50Hz - 15kHz.Sensitivity 69dB.

Cat No.C10170.

1-9	10+	100+	1000+
$1.70	$1.50	$1.40	$1.20

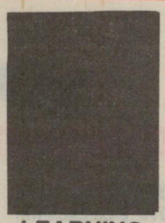
"TALKING ELECTRONICS" BOOKS



ELECTRONICS FOR MODEL RAILWAYS

This is the ideal book for the railway enthusiast. If you don't know too much about electronics or even if your experienced this books gives you a range of projects for you to complete. From a simple level crossing flasher that beginners can build to a project for a little microcomputer that is quite complex Not only will it drive a set of traffic lights it will automatically turn your street lights on when it gets dark . Other projects include: Level crossing lights, economy power supply, signals tunnel stretcher and station signal delay modules, diesel sound generators. 74 pages

B10044.....$3.80



LEARNING ELECTRONICS BOOK 1.

This book on electronics starts at the beginning and covers modern electronics in an exiting way. It has been written to answer a question often asked " where do I start.?" Each chapter covers one or more components and includes a set of experiments to show how the components work. This book covers resisters. LEDs, capacitors, diodes, transistors audio amplifiers and digital electronics. 73 pages.

B10040.....$3.50

LEARNING ELECTRONICS BOOK 2.

This is the second book in the series to help you learn in the most interesting way possible. This book combines theory with projects that can be used in your workshop or around the home. This issue covers the power supply, plug pack regulators, logic probes, continuity testers, intercoms, square wave oscillator, 2 chip AM radios and more! 73 pages

B100041.....$3.95

14 FM BUGS TO BUILD

FM transmitters are so effective that they have become one of the most popular kits You can use these bugs for all kinds of field work, picking up the sounds of the bush, talking between two parties or monitoring your own property. Projects in this book have been presented in order of complexity, with these simple bugs at the beginning and working through more complex designs.73 pages

B10042.....$3.50

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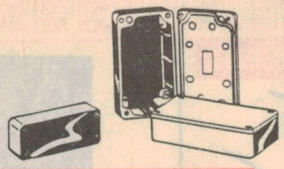
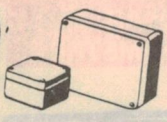


GREAT VALUE! COMES WITH BUILT IN RUBBER GASKET AND WEATHER PROOFING.



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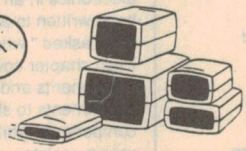

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H30350	190x100x60mm	$12.95	$10.95
H30355	190x100x80mm	$14.95	$12.95

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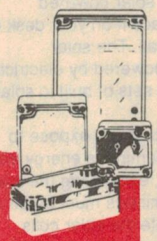

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H30120	115x65x55mm	$12.95	$10.95
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H30140	171x121x55mm	$20.95	$18.95
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CHIMING CLOCK MOVEMENT

A quartz crystal clock movement with a combined microchip chimes generator and amplifier pcb, driving a 57mm diameter moving coil loudspeaker. The chimes generator and amplifier module is powered separately by an additional two AA cells and two control wires from the clock module causes tunes to be produced hourly. The microchip follows this sequence every hour and usually needs to be 'synchronized' to the actual time with the aid of the manual sequencing click switch provided which simulates the closing of the clocks contacts. The whole assembly can be mounted in a custom clock case. Note: this movement does not come with hands.

A10078.....$19.95

TABLE ALARM CLOCK MOVEMENT

A standard quartz movement with an alarm function and special set of four hands. One of which is a set alarm time indicator. The alarm sounds where the hour hand aligns with the alarm set hand. Separate set time and set alarm knobs are provided on the back with an alarm on/off switch. The alarm clock is provided with two mounting holes through the case.

SPECS:
Operating voltage: 1.3-1.7V DC
Alarm Volume: 80db @ 10cm
Demnsions: 52 x 55 x 23mm not including hand pivots.
Length and colour of hands measured from the centre pivots
Hour (white): 19mm
Minute: (black): 26mm
Second (red): 26mm
Alarm set (yellow) 20mm

A10077.....$15.95

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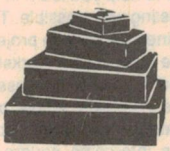

Plastic boxes with plastic lids. Comes with 4 screws Black in colour.

H10128 83 x 54 x 28mm..... **$1.95**
H10126 130 x 68 x 41mm....**$2.50**
H10122 150 x 90 x 50mm....**$3.95**
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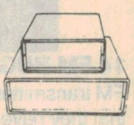
NEW CASES



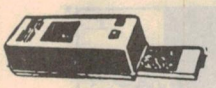
Beige plastic moulded cases with aluminium end panels

160mm (W) x 55mm (H) x 170mm (D). H10204.....**$22.95**
110mm (W) x 46mm (H) x 146mm (D). H10202.....**$18.95**

EPROM SPECIALS

	1-9	10-25	25+
27C64-20	$4.50	$3.90	$3.50
27C256-20	$5.00	$5.00	$4.50
27C512-15	$6.00	$5.50	$5.00

EPROM ERASER With Timer



Sure it erases your EPROM's quickley and safely and will erase up to 9 x 42 pin devices in about 40 minutes. (less for less chips). But with this one you don't have to waste your time standing around waiting for them. The EPROM has a timer which allows you to "set and forget". By using the timer function it not only saves you money by reusing your EPROM's but you also save presious time doing other jobs while the eraser is working. And you'll never have to worry about turning it off and "cooking" your EPROM's. Choose from a wide range of different settings from 15 minutes to 40 minutesdepending on the intensity of the UV source.
*The chip door has a conductive foam pad.
*High intensity at the chips surface ensures EPROM's are thoroughly erased.
*Engineered to prevent UV exposure.

X14955
SAVE $40 NOW JUST $129.00
X14950
WITHOUT TIMER
Was $109.00 Now just $89.00
Spare UV tube for Eraser
X14957.....$14.95

BNC CONNECTORS

BNC JACK TO BNC PLUG "L" TYPE.
Great for Network cards at the back of computers.
P10526.....**$6.95**

BNC FEMALE LINE JACK TO SUIT RG5
P10535.....**$2.95**

MIC 3 PIN LINE SOCKET
P10280.....**$6.95**

BNC "T" ADAPTOR

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P10505....	$5.95	$4.95

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2M 50 ohm cable.....$8.95
3M 50 ohm cable.....$12.95
5M 50 ohm cable.....$16.95
10M 50 ohm cable.....$26.95
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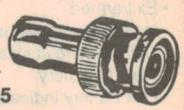
NEW LOWER PRICED TERMINATION PLUGS

BNC plug terminations suitable for completing a network section, absorbing impluses and preventing termination.
50 ohm impedance

BNC TERMINATOR
93 ohm Arcnet 1-9 10+
P10528.....$3.95 $3.45



BNC TERMINNATOR
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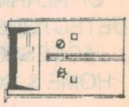
C92100.....$51.00

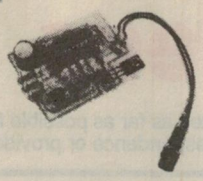
EPSON INK CARTRIDGE SO20002 FOR SQ850/22550 INK CARTRIDGE
C22089.....$66.00



SAMSUNG SP0912/2412 1-9 10+
C21266.....$18.95 $17.05
SAMSUNG SP2421 1-9 10+
C21270.....$29.95 $26.95

NEW KITS NEW KITS NEW KITS

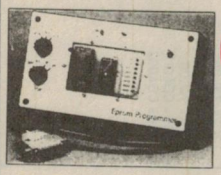
K10140 not supplied with automotive connectors



A LOW FUEL INDICATOR FOR YOUR CAR

This is a very handy kit designed so you never run out of petrol again. The low fuel indicator is easy to build and can be installed in most vehicles. It lights a 12V warning lamp when the fuel in the petrol tank drops below a preset level. If you ever runout of petrol or have come close to doing so, this project is well worth building. It could save you quite a few dollars. Not to mention embarrassment and inconvenience. Silicon Chip Feb. '93

K10140.....$11.95



FREE PACK & POST ON THIS KIT

PC-CONTROLLED EPROM PROGRAMMER

Experimenting with Microprocessors is great fun, but it can be a lot easier and more productive with a few specialised pieces of equipment. One of these valuable extras is an EPROM programmer which is very flexible and is controlled from a standard PC printer port. As well as programming EPROMs it also has a readback feature. Commercially available programmers start around $250.00 But this project is designed to be inexpensive yet be a reasonably powerful and flexible progammer. EA Sept & Oct. '93

K10415.....$98.95

FM WIRELESS MICROPHONE

This is a very handy idea. An easy to build miniature FM radio mic with circuitry that is very stable and sensitive. It can be used in many ways such as a baby monitor, a monitor for a distant telephone, or use it as a one way intercom. Can be easily picked up on any FM Receiver. Comes with PCB and componentsNew PCB design Silicon Chip Nov '89

K10410.....$19.95

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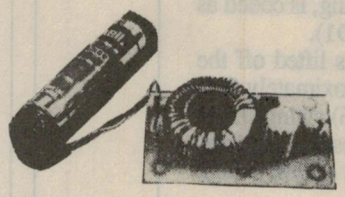
COLOUR VIDEO FADER

This is a great idea for the budding movie director in your home. Get rid of those sharp jaggered cuts from scene to scene with this low cost colour video fader. Make clean smooth edits on your VCA. Fade down to a black screen and fade up to the next scene. Giving your movies that professional look. You can also create special effectssuch as a "wipe screne" facility. Comes complete with all components, P.C.B hardware including easy to mount one hole 2.1mm DC socket, zippy box, IC sockets, Front panel and case sid labels Silion Chip Aug '93.

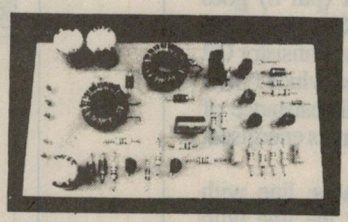
K10405.....$32.95



1.5V TO 9V DC CONVERTER

Sick of how quickly 9 volt batteries go flat? Then switch over to more cost-effective 1.5 volt cells with this 1.5V to 9V DC converter. It uses just three components and fits on a small PC board. The TL486 is a very compact DC setup switching converter IC which provides a regulated 9V DC output. It only requires a filter capacitor and an inductor to get going and can be operated from an AA, C or D cell. S.C Sept 1993

K10100.....$13.95

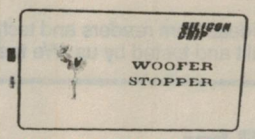


+5V TO ±12V DC CONVERTER

This low cost project uses only junkbox components to convert a +5V DC supply to ±12V DC rails (24V total) capable of supplying up to 100mA. What's more you can easily change it to provide other output voltages.
Silicon Chip Sept. '93

K10160.....$17.95

FREE PACK & POST ON THIS KIT



WOOFER STOPPER

Got a problem with your noisy neighbour's dog barking at all hours of the morning? Well now you can shut it up without making a sound (that is a sound which can't be heard by humans). The woofer stopper emits a high-level supersonic tone that lasts for about nine minutes.
The tone has a frequency of about 20kHz. If the device is used a regular basis, the animal eventually realises that it's going to be repremanded if it barks and eventually ceases to be problem. Silicon Chip May 1993

K10400.....$55.95

FREE PACK & POST ON THIS KIT

IN-CIRCUIT TRANSISTOR TESTER

Do you have box full of unknown transistors or a transistor circuit that s not working properly? This simple tester will indicate whether a transistor is working or not and tell you whether it is an NPN or PNP type. It is invaluable for trouble shooting. You don't even have to pull the transistor out of the circuit to test it.
Silicon Chip Sept '93

K10200. .....$14.95

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REMOTE CONTROLLED ELECTRONIC COCKROACH

Test your electronic and mechanical skills by building this steering controlled electronic cockroach. You just put it on the ground, switch it on and steer it left or right by pressing one of two buttons on the hand held transmitter. It consists of a PC board, two small motors, and a handfull of cheap components to make the control circuitry and IR transmitter.
Silicon Chip Sept '93

cat no. $69.95

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PLEASE CHECK AVAILABILITY OF KITS AS NEW ONES ARE SUBJECT TO PARTS AND PRODUCTION AVAILABILITY.

Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide further information.

Telephone STD bar

This circuit detects any dialled phone numbers which begin with '0' and automatically drops out the line for 30s, cancelling the call. It is designed to work only with tone dialling phones.

With tone dialling, pressing a key generates two tones — a row and a column frequency. The zero digit (which is row 4, column 2 on the phone pad) generates 941 and 1336Hz, respectively. By using a two-tone system, only seven frequencies are needed to code the 12 keys on the phone pad.

When such a two-tone signal is fed into an MC145436 decoder chip (IC3), the two frequencies are converted into a binary number, which the IC outputs via D8, D4, D2 and D1. The zero tone, which we are interested in detecting, is coded as decimal 10, giving the binary output 1010 (D8-D1).

The circuit begins operation when a phone is lifted off the hook. The op-amp IC1 (LF356) detects the approximately 50V DC now on the phone line, and its output (pin 6) swings high. This positive-going pulse activates the master reset of the five-stage Johnson counter IC5 (4017), resetting its output 0 high and outputs 1-9 low.

When the first digit is dialled, as well as producing a decoded binary output for D8-D1, IC3 also sends a 'data valid' (DV) output via pin 12. As this pin goes high, it clocks IC5, sending the 4017's pin 2 (output 1) high.

If the first digit dialled was zero, pins 13, 14, 1 and 2 of IC3 output 1010. Since the outputs of D4 and D1 are inverted by IC6a and IC6b (half of a quad 4093 NAND gate), this feeds four high inputs into the IC4 NAND gate. The net result is that all eight inputs to IC4 will high *only* for the first digit dialled, and *only* if this digit is zero.

When this combination occurs, IC4's output (pin 8) goes low, which activates the monostable based on IC6c and IC6d. For the 30s that the output (pin 11) of IC6d is low, transistor Q2 is switched off, and the relay RLY1 is de-activated which opens switch SW1. (RLY1 is a 12V relay, with a coil resistance of 220 ohms.) Calls can be made only while the relay is energised, so dialling a zero first drops out the call.

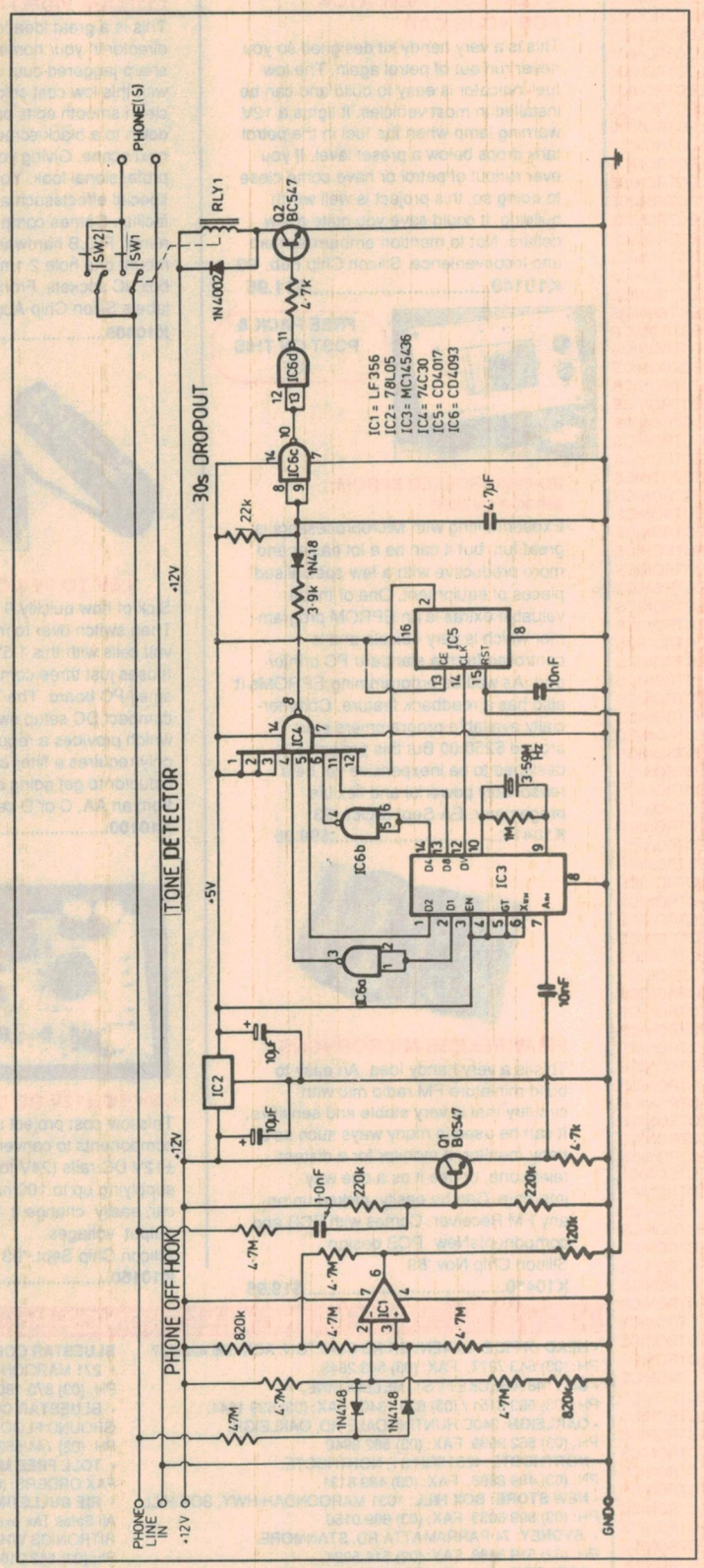
The on-hook/off-hook detector loads the phone line with 50M, DC coupled; while the tone input loads the line with 4.7M, AC coupled. These values should not cause problems. The manual bypass switch SW2 is fitted to allow the phones to be used if there is a mains power failure, with the subsequent loss of the 12V supply to energise the relay coil.

On IC3, a logic 1 is applied to the $\overline{\text{XEN}}$ (pin 6) to enable the on-chip crystal oscillator, which works in parallel with the resonant crystal and a 1M resistor connected to pins 9 and 10. Logic 1 is also applied to GT (pin 5) to lengthen the tone detect time (and shorten the release time).

With the longer guard time, there is less chance that tones simulated by speech will maintain signal conditions long enough to be accepted. In addition, with the shorter release time, a pause in speech is less likely to accepted as a valid pause. (The phone signal time, and the pause between tones, are both nominally 100ms.)

Murray Bacon,
Auckland, NZ

$50



Guitar distortion

Distortion or overdrive is a classic effect for guitarists. This circuit is the result of considerable research into distortion and semiconductor transfer characteristics, and is more than just a simple clipper 'fuzz' unit. The circuit has a high input impedance to take the guitar input directly, via SKT2 (6.5mm phono socket). Following this is an input amplifier built around IC1a (TL072), which has a variable gain between 1 and 18 controlled by RV1. This controls the amount of overdrive.

The signal is then fed into a MOSFET amplifier IC2 (4007UB), which uses the inverter IC2a and one of the dual complementary pairs IC2c. This simulates an over-driven valve amplifier, giving even order harmonics. The gate (pin 3) of the unused pair IC2b should be tied to ground.

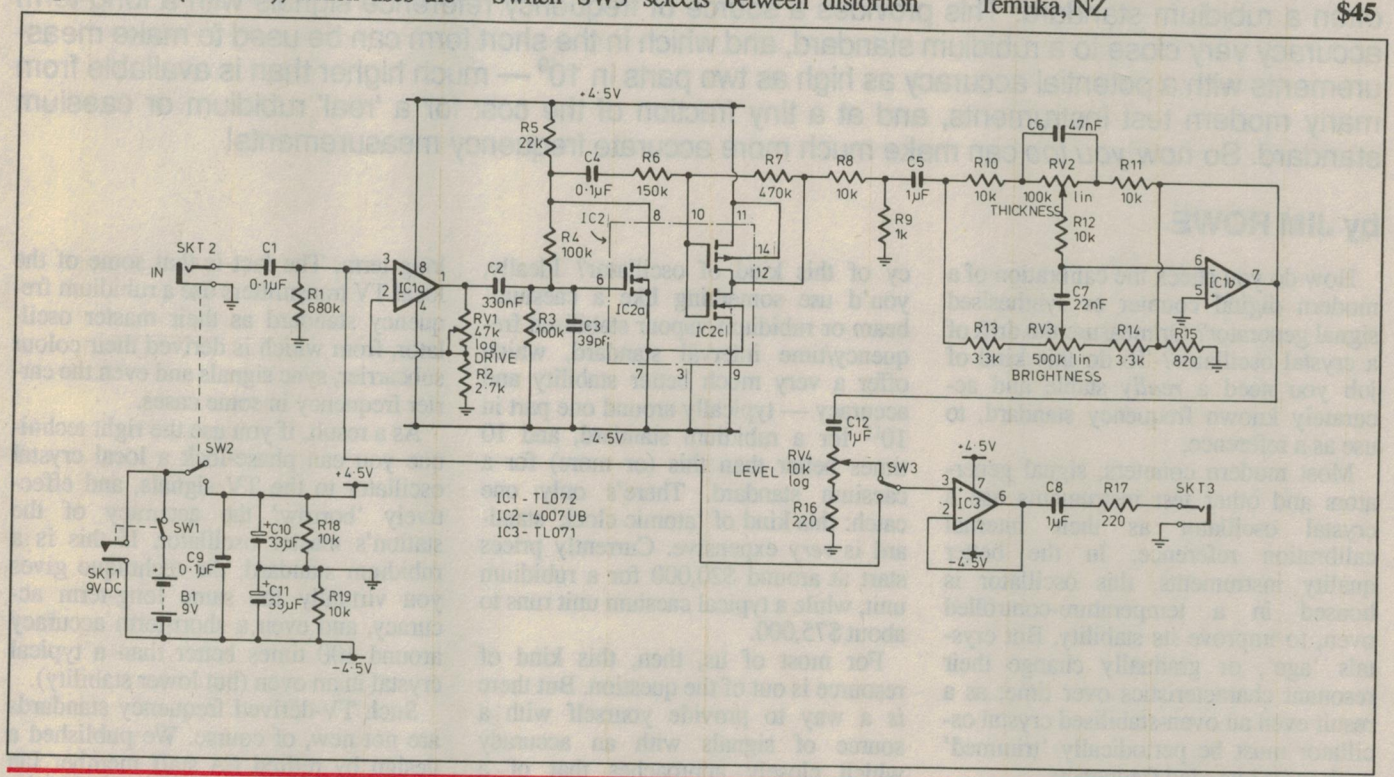
A tone control circuit, based around IC1b, allows the harmonic content to be adjusted to suit the style of music. RV2 is a bass cut/boost which controls how 'thick' the distortion is, while RV3 is a treble cut/boost which alter the 'brightness' of the signal.

The output of IC1b is fed into a level control RV4, which is set to match the distortion level to the natural guitar level. Switch SW3 selects between distortion and clean sound, and the signal is then buffered by IC3 at the output.

Power may be supplied from a 9V battery or a regulated plugpack, with a switch SW1 on the input jack SKT1 used to disconnect the battery when a plugpack is used. Another switch SW2 on the signal input jack SKT2 is used to switch the circuit on and off.

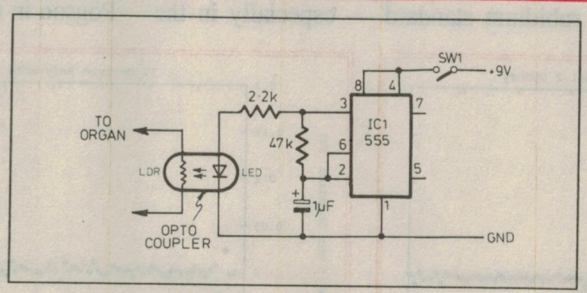
As it stands, the unit will give effects from mild overdrive suitable for 'rock' and 'blues' music, through to the heavy distortion and tenacious sustain of 'hard rock' and 'heavy metal'.

Julian Phillips,
Temuka, NZ **$45**



Add-on vibrato

I wanted to improve the sound from a toy polyphonic organ. The attached circuit does this pretty well as an add-on vibrato, without having to dig deeply into the original electronics.



It works by connecting a resistor (LDR) across the whole (or part) of the organ's volume control pot. Switching this resistor in and out of the circuit with a 555 timer in the astable mode gives the vibrator effect.

The rate of vibrato can be varied by using a different value for the 47k resistor; and the depth of vibrato can be altered by changing the value of the 2.2k resistor.

My opto-coupler was made from a LED and a nameless LDR pushed into opposite ends of a short black plastic tube — part of an old pen. The unit's control leads from the LDR were connected across the whole of the original volume control, but it's worth trying connecting them from the wiper to the earthy end of the pot. Sure, the modulation of volume is square rather than sinusoidal, but this is a quick fix for a toy!

A.J. Lowe,
Bardon, Qld **$40**

DREAMED UP A GREAT IDEA?

If you have developed an interesting circuit or design idea, like those we publish in this column, why not send us in the details? As you can see, we pay for those we publish — not a fortune, but surely enough to pay for the effort of drawing your circuit, jotting down some brief notes and popping the lot in the post (together with your name and address) and send them to Jim Rowe at -

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Construction Project:

LOW COST TV-DERIVED FREQUENCY REFERENCE - 1

Think of this project as a kind of 'poor man's rubidium standard'. It uses the sync pulses from a received TV signal to phase-lock a local crystal oscillator to the station's master oscillator, which is often a rubidium standard. This provides a source of frequency reference signals with a long-term accuracy very close to a rubidium standard, and which in the short term can be used to make measurements with a potential accuracy as high as two parts in 10^9 — much higher than is available from many modern test instruments, and at a tiny fraction of the cost for a 'real' rubidium or caesium standard. So now *you too* can make much more accurate frequency measurements!

by JIM ROWE

How do you check the calibration of a modern digital counter or synthesised signal generator? Or measure the drift of a crystal oscillator? To do this kind of job you need a *really* stable and accurately known frequency standard, to use as a reference.

Most modern counters, signal generators and other test instruments use a crystal oscillator as their internal calibration reference. In the better quality instruments, this oscillator is housed in a temperature-controlled oven, to improve its stability. But crystals 'age', or gradually change their resonant characteristics over time; as a result even an oven-stabilised crystal oscillator must be periodically 'trimmed' back to its intended frequency.

So how do you check the frequency of this kind of oscillator? Ideally, you'd use something like a caesium-beam or rubidium-vapour stabilised frequency/time interval standard, which offer a very much better stability and accuracy — typically around one part in 10^{11} for a rubidium standard, and 10 times better than this (or more) for a caesium standard. There's only one catch: this kind of 'atomic clock' standard is *very* expensive. Currently prices start at around $20,000 for a rubidium unit, while a typical caesium unit runs to about $75,000.

For most of us, then, this kind of resource is out of the question. But there *is* a way to provide yourself with a source of signals with an accuracy which closely approaches that of a rubidium standard — especially in the long term. The fact is that some of the local TV transmitters use a rubidium frequency standard as their master oscillator, from which is derived their colour subcarrier, sync signals and even the carrier frequency in some cases.

As a result, if you use the right technique you can phase-lock a local crystal oscillator to the TV signals, and effectively 'borrow' the accuracy of the station's master oscillator. If this is a rubidium standard, the technique gives you virtually the same long-term accuracy, and even a short-term accuracy around 100 times better than a typical crystal in an oven (but lower stability).

Such TV-derived frequency standards are not new, of course. We published a design by retired *EA* staff member Ian Pogson in the July and October 1989 is-

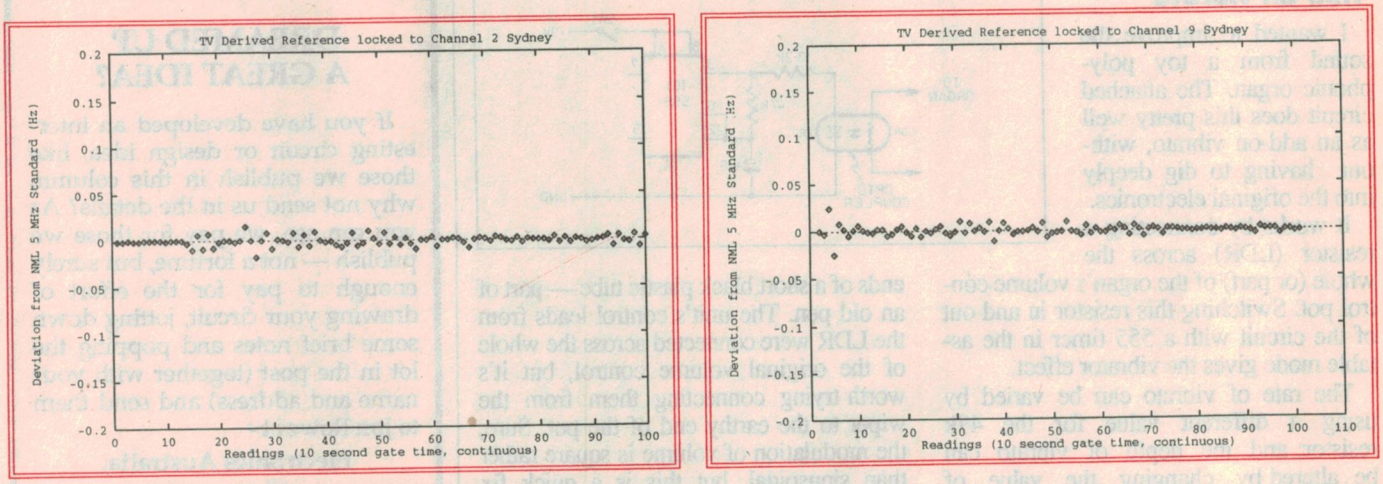
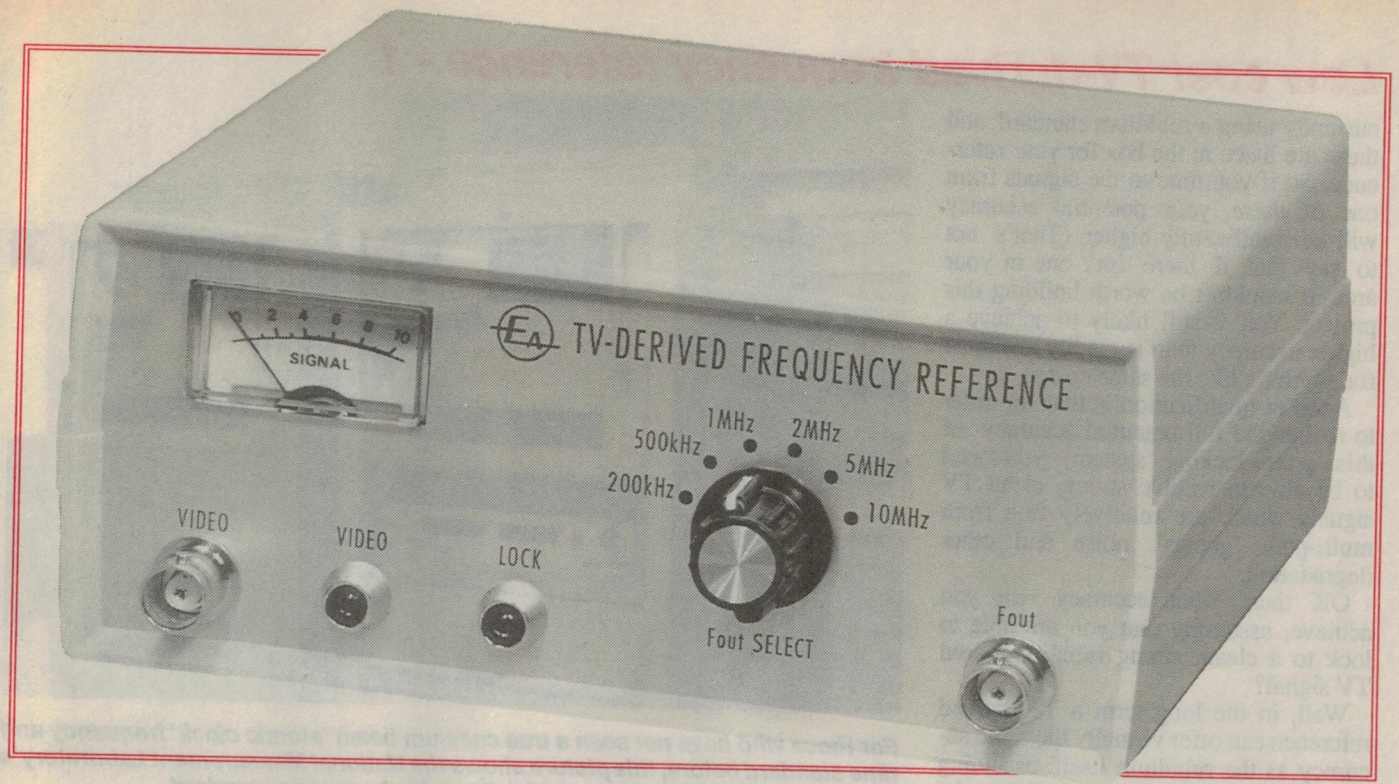


Fig.1: Plots produced by the CSIRO's national measurement laboratory, showing the 5MHz output of the TV derived frequency reference, when locked to Sydney's ABN2 and TCN9 respectively, compared against the lab's own caesium beam standard. These plots are for the measurements made with a 10-second gating time.



sues, for a complete Time and Frequency Standard based on this technique. More recently, in the April 1991 issue, we published the circuit for a much simpler TV-locked Frequency Calibrator developed by reader Bob Parker, in the 'Circuit and Design Ideas' section.

The new design presented here is an attempt to provide a full construction project, which also goes a little further than Bob Parker's circuit, but is at the same time rather less complex and less costly than Ian Pogson's design.

The decision to develop the new design arose from many requests we've received. It became clear that while many people would dearly love a source of really accurate signals to make frequency measurements, often they don't really need a full *time* reference as well. So the challenge became this: could I come up with a low cost, easy to use unit which provides the accurate signals needed for serious *frequency* measurements — by leaving out some of the circuitry and facilities need for a full-blown time reference?

One of the main things demonstrated by Bob Parker's design was that if you only want such a frequency reference, there's really no need to go to an oven-stabilised crystal oscillator of the type used by Ian Pogson. You can use a standard 'naked' crystal oscillator, and rely on the PLL (phase-locked loop) to hold it in lock — on the assumption that TV signals will always be available when most people will be making measurements, or if they're not, that the measurements can be delayed until they are.

Leaving out the temperature-regulating oven does allow a very significant reduction in complexity and cost, it turns out.

The other assumption made by Bob Parker in his design was that many people have an old VCR or TV receiver, which can be used to provide composite video signals for the frequency reference, obviating the need for it to have its own complete 'front end'. This is quite a reasonable assumption nowadays, and there's also a very significant saving if the front end circuitry is left out.

Finally, although a unit to be used as a time reference tends to need a frequency divider chain running down to 1Hz, this isn't normally required for frequency measurement use. Hence a small additional saving in complexity and cost can be achieved by restricting the range of output frequencies.

To cut the story short, by adopting these measures I have been able to produce a TV-derived frequency reference which should (I believe) meet the needs of many people, while being easy to build and get going, and yet only costing around $70.

How good *is* it?

The obvious question to ask is just what kind of accuracy and stability such a low cost unit can provide. The answer comes in two parts.

First, the accuracy inevitably depends upon the TV signals you lock it to. Only some TV broadcasting transmitters use a rubidium master oscillator in their 'SPG' (sync pulse generator); the rest appear to use oven-regulated crystal oscillators. While the latter are perfectly OK in terms of normal TV reception, they obviously can't provide the same degree of accuracy as a rubidium standard, for our current purposes.

Luckily we've been able to find out which TV transmitters in Australia are

Measurement Type	Channel 2		Channel 9	
	Mean Hz	Deviation Hz	Mean Hz	Deviation Hz
1 Second Continuous	5000000.00	± .07	5000000.00	± .03
1 Second Delayed	5000000.00	± .07	5000000.00	± .08
10 Second Continuous	4999999.999	± .02	5000000.000	± .03

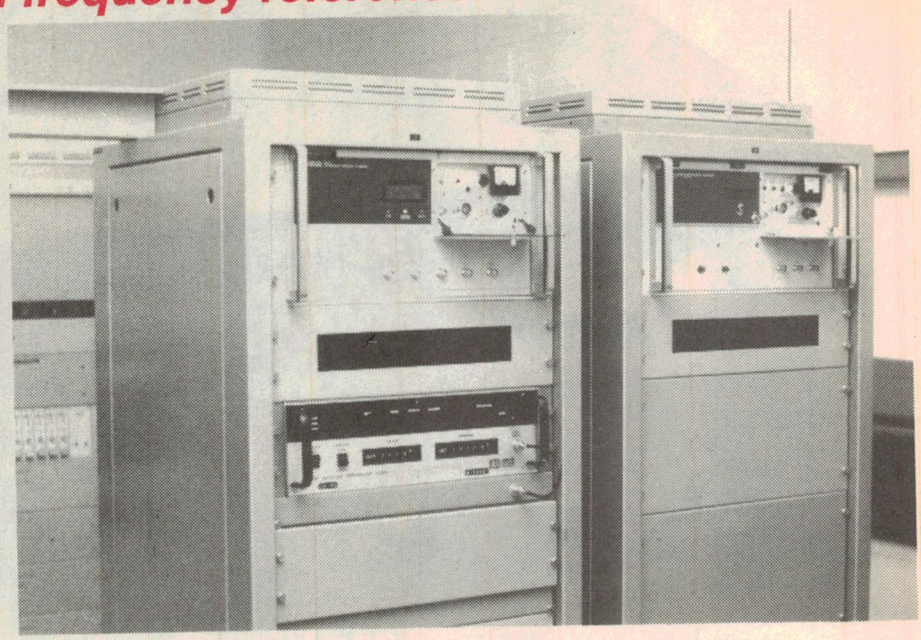
Table 1: The summary of test results given in the NML report, for each of the six measurement runs. The deviation figures shown are maximum or 'peak' deviation figures, and include measurement uncertainty where applicable.

currently using a rubidium standard, and these are listed in the box for your reference. So if you tune to the signals from one of *these*, your potential accuracy will be significantly higher. (That's not to say that if there *isn't* one in your area, it wouldn't be worth building this project. You're still likely to achieve a higher accuracy than is readily available for anything like the same cost.)

Another qualification is that in order to realise the full potential accuracy of this phase-locking system, you need to be able to receive strong, clean TV signals which are relatively free from multi-path 'ghosts', noise and other degradation.

OK then, what accuracy *can* you achieve, assuming that you are able to lock to a clean, strong rubidium-based TV signal?

Well, in the long term a TV-derived reference can offer virtually the same accuracy as the rubidium itself, assuming you make sure it stays in lock. But in the short term it can't achieve quite this same accuracy, because of the inevitable minor disturbances due to TV signal propagation variations, transient ghosting due to planes flying overhead, man-made noise and noise jitter in the local phase-locked loop. There has to be *some* degradation, as a result...



For those who have not seen a true caesium beam 'atomic clock' frequency and time standard before, this picture shows the National Measurement Laboratory's two Hewlett Packard units — which form the Australian standard.

Tested by CSIRO

To find out *how much* degradation these largely unavoidable disturbances produce, I took my prototype unit up to the CSIRO's National Measurement Laboratory, which is part of the Division of Applied Physics in Sydney. One of the functions of the NML is to maintain Australia's official standards for frequency and time interval, and it does this by maintaining a number of extremely accurate standards — including both a pair of caesium-beam primary standards and two hydrogen masers. So there's scarcely a better equipped lab in Australia, for making extremely accurate frequency or time-interval measurements.

By leaving the unit there for a couple of days, we were able to have its performance checked against one of the NML caesium standards. The NML's John Thorn and Stephen Quigg very kindly carried out these tests, which essentially compared the locked 5MHz output of our unit against the 5MHz output from the caesium standard. However the findings would really apply equally to all six of the unit's output frequencies, as they are all taken from the same 10MHz crystal oscillator via digital dividers.

At my request, the NML did two separate sets of tests, each with the unit locked to one of the two Sydney TV stations which use a rubidium reference: the ABC's ABN-2, and the Nine Network's TCN-9.

In each case measurements were taken

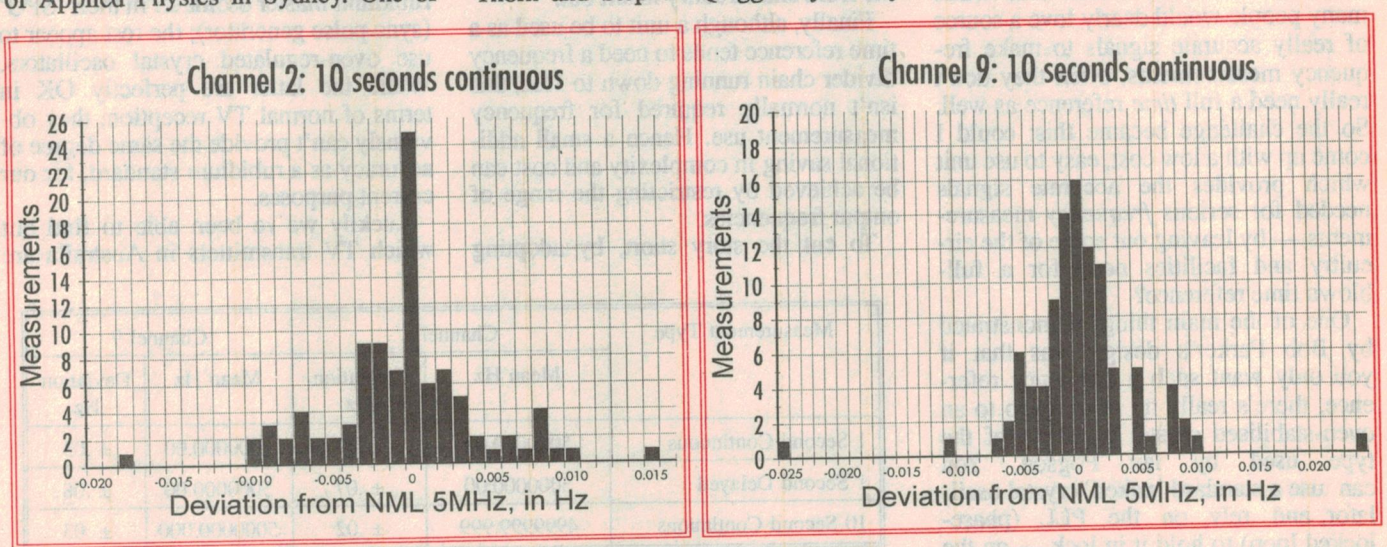


Fig.2: Histograms produced by the author from the NML 10-second gating time measurements (as plotted in Fig.1), showing the high proportion of individual measurements clustered within .01Hz of the mean. Because of this clustering, statistics suggests that the effective accuracy of the TV derived reference can be improved by averaging a series of measurements.

Gating Time	Single Meas.	5-meas. mean	10-meas. mean	20-meas. mean	50-meas. mean	Standard Deviation (RMS Error)
1 sec	+/-2 in 10^8 (+/-0.1Hz)	+/-1.5 in 10^8 (+/-0.06Hz)	+/-1 in 10^8 (+/-0.05Hz)	+/-8 in 10^9 (+/-0.04Hz)	+/-8 in 10^9 (+/-0.04Hz)	+/-4 in 10^9 (+/-0.02Hz0
10 sec	+/-1 in 10^8 (+/-0.05Hz)	+/-5 in 10^9 (+/-0.03Hz)	+/-4 in 10^9 (+/-0.02Hz)	+/-2 in 10^9 (+/-0.01Hz)	+/-2 in 10^9 (+/-0.01Hz)	+/-1 in 10^9 (+/-0.005Hz)
	(NML)	(95% Confidence Level)				

(Frequency figures in brackets refer to error measuring a 5MHz signal)

Table 2: A summary of the performance of the TV derived reference, which should serve as a guide when using it as a timebase for making measurements. Note that the 'single measurement' accuracy figures are as measured by NML, while those shown for multiple measurement means are statistically derived from the standard deviation.

with both one-second and 10-second gating times, and over both short (a few minutes) and long (15 - 16 hours) time intervals. The results they obtained are summarised in Table 1. As you can see, they show that when locked to *either* of the rubidium-based signals, the unit's 5MHz output frequency was always within +/-0.1Hz of the equivalent caesium-derived signal.

In fact the 10-second gated measurements were always within +/-0.05Hz, which corresponds to +/-1 part in 10^8, which is already about 100 times more accurate than the basic crystal timebase used in most lower-cost counters.

Even more interestingly, when *plotted* the measurements showed that for a high proportion of the time, the unit's accuracy was in fact significantly better than this. This was especially evident for the measurements taken with a 10-second gating time, where presumably some of the minor short-term variations were averaged out. (The measurement resolution was also 10 times higher, and the measurement uncertainty correspondingly reduced.)

Fig.1 shows the NML plots for the 10-second gated measurements for the unit, when locked to both ABN-2 and TCN-9. Similarly Fig.2 shows the corresponding histograms I plotted myself for the same measurements, showing how most of them (over 95%) are grouped quite closely about the mean — within +/-0.01Hz, in fact. In view of this, I decided to brush up on statistics and analyse the NML measurements a little further.

First, I calculated the standard deviation (RMS error) for each NML measurement run. Then, assuming that Student's 't' distribution would apply to this kind of measurement (i.e., that the measurement errors are largely random), I calculated the expected measurement error tolerance for a 95% confidence level, if a *series* of separate measurements were taken and their results averaged. The final results are summarised in Table 2.

As you can see, the NML results are essentially shown in the first data column, showing that for single one-second gated measurements the accuracy you can reasonably assume from the unit as a timebase is within +/-2 parts in 10^8, with twice this accuracy for single 10-second gated measurements.

The next four columns show the improvements in measurement accuracy you could expect, with a 95% confidence level, by taking either five, 10, 20 or 50 measurements and calculating their mean. These are all based on applying Student's 't' distribution to the standard deviations of the NML measurements, which are shown in the final column.

It's fairly clear that there isn't much point in averaging more than about 20 measurements; beyond this number, there's little improvement. However by taking at least 20 measurements, there *is* likely to be a roughly fourfold improvement in accuracy — to better than +/-1 part in 10^8 for measurements with a one second gating time, and around +/-2 parts in 10^9 for measurements with a 10-second gating time.

Note that all of these figures refer *only* to the accuracy of the signals from the TV-derived reference themselves, as a timebase. They do *not* apply automatically to the accuracy of measurements made using them, using say a counter. To determine the accuracy of such measurements, you'll need to take into account other sources of measurement error — such as gating 'bobble', counter resolution and so on.

So there you have it. In a nutshell, our new TV-derived frequency standard delivers reference signals with a basic accuracy of at least +/-2 parts in 10^8, and if you use 10-second gating and average 20 measurements or more, up to around +/-2 parts in 10^9, *when locked to a rubidium-based TV signal*. This is much more accurate than most of us could achieve by any other means — and all from a box of parts which will cost you only about $70!

As noted earlier, this accuracy specification will apply to all six of the unit's available output frequencies: 10MHz, 5MHz, 2MHz, 1MHz, 500kHz and 200kHz. This should make the unit very suitable for use as an external high-accuracy timebase, for counters and synthesiser-type signal generators.

By the way, copies of the full NML test report on the prototype unit are available from the Reader Information Service, for those who are interested. The usual fee of $7.50 applies, however, to cover photocopying and postage.

That's all we have space for this month, unfortunately. In the second article I'll give a complete circuit description, plus full construction and adjustment information for the unit. ❖

Rubidium-based TV stations

As far as we have been able to determine, the following Australian TV stations are currently broadcasting signals based on rubidium frequency standards:

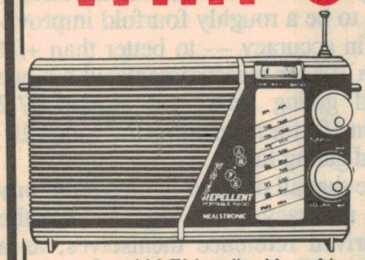
ABC stations: The capital city stations in Sydney, Brisbane, Adelaide, Perth and Canberra, plus regional stations in the North-East, South-East, South Australian and Western Australian Optus satellite footprints. This means essentially all regionals in NSW, Queensland, South Australia and Western Australia. The transmitters in Victoria (including Melbourne and Albury), and Tasmania use oven-controlled crystal oscillators.

Commercial stations: The main Nine Network stations in Sydney, Melbourne, Launceston and Perth, plus some of the same network's UHF translators on the NSW central coast (e.g., North Head, Forrester's Beach). Virtually all other commercial stations, plus the SBS stations, use oven-controlled crystal oscillators.

Our thanks to the chief engineers of the various networks, for supplying us with this information.

DICK SMITH ELECTRONICS

Get Busy With Our Latest KITS

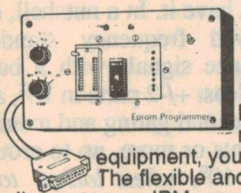


Build Your Own AM/FM Radio!

If you're intrigued by the way a radio works, this is the ideal kit to learn from. With the help of our comprehensive instructions, all you have to do is solder the components onto the circuit board, assemble all the hardware bits and you'll end up with a professional looking and sounding AM/FM radio. Your friends won't believe you built it yourself - the portable radio is very impressive with a large speaker for great sound. Plus, it runs on three 'C' sized batteries for long-life and is water resistant. It's simple to align due to the single IC circuit, though some experience with soldering is necessary. The kit comes complete with all components, hardware, plastic casing with rubber seals, carry strap and telescopic antenna.
(Batteries not included.)

COMING SOON! Cat K-1042 **$49.95**

EA Oct '93



Low-Cost Computer Programming

Eprom Programmer

Ever wanted to write instructions to control a microprocessor? With this sensational piece of equipment, you can program EPROMS the inexpensive way! The flexible and powerful programmer is controlled via the parallel port on an IBM compatible PC. It not only allows you to program EPROMs but it also has a readback feature. The hardware can handle EPROMS from 2716 (2K x 8) to 27256 (32K x 8) and it will also program 2816 and 2864 electrically erasable (EE) PROMS. Comes in full form with all components, hardware including 2 quality EPROM test sockets, case and pre-punched screened front panel.

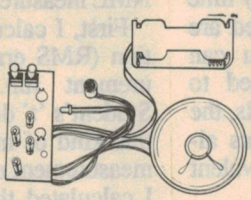
EA Oct '93 **NEW!** Cat K-3602 **$99**

Are Your Transistors In Working Order?

Incircuit Transistor Tester

You'll find this Transistor Tester extremely handy for indicating whether or not transistors are working properly and for distinguishing between NPN and PNP types. It can test both small signal and power transistors and, if faulty, indication will be given by 2 LEDs. Additionally, the kit can be used to test transistors that are already in circuit, making it invaluable for trouble-shooting. Comes complete with all components, PCB, hardware (including test clips), case and a pre-punched silk-screened front panel.

Silicon Chip Sep '93 Cat K-7218 **$22.95**

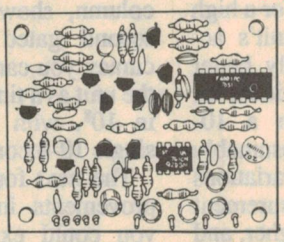


Now There's No Excuse For Not Getting The Message!

Message Recorder Module

Leaving messages will be a breeze when you use This module assemble this kit and the chance of them being misplaced will be minimised! It's a simple and compact unit that allows you to record up to 16 seconds of sound and to play it back. Using a single surface mounted IC, the sound is picked up by an electret microphone, converted to a digital signal, and then stored ready to be played back. The unit is supplied as a pre-assembled module, ready to use once power is connected. Module comes complete with PCB, digital storage chip, mic. insert, record LED, mini speaker and battery holder.

NEW! Cat K-9200 **$34.95**

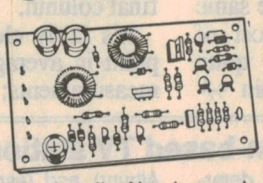


Tune In To Hidden Signals!

ACS Decoder

Now you can get more from your favourite FM radio stations! By taking advantage of the Ancillary Communications Service (ACS) that's employed by many FM broadcasters, you'll be able to listen in to special-purpose channels. These channels are only accessible by an ACS decoder. Everything is mounted on a single PC board that's compact enough to fit in most small receivers - it operates on a supply between 6V to 30V. Instructions show how to install the ACS decoder into our A-5235 Digitor AM/FM portable stereo. Kit will be supplied in shortform with PCB and components only.

EA Sept '93 **NEW!** Cat K-5020 **$18.95**



The Dual-Power Solution!

5V DC To ± 12VDC Converter

A low-cost project designed to resolve the problem caused by using plug packs when your projects require dual supply rails. No plug packs that are readily available supply this and, while there are alternatives to obtaining dual supply, they are considerably more complicated and time consuming. This kit will produce separate positive and negative 12V rails (at currents of up to 100mA) with an input supply of anything from 5 to 10VDC and you can easily adjust the output voltage to suit your own application. Plus, it can run on any source of power including: Rectified DC voltage from the mains, solar or car battery. Comes in short form, complete with all components and PCB.

Silicon Chip Sep '93 Cat K-3229 **$18.95**

PLEASE CHECK YOUR NEAREST STORE FOR AVAILABILITY, AS SOME KITS MAY STILL BE IN PRODUCTION.

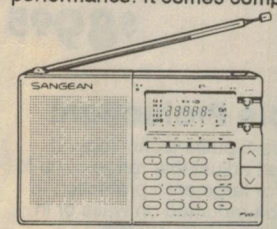
Tune In To The World!

Yaesu Receiver

Advanced Features For High Performance!

This sensational FRG-100 high performance communications receiver gives extended coverage of the 50kHz to 30MHz range in AM, SSB, CW and FM (optional) modes, as well as a huge range of new features. It provides the user with easier access to most receiver functions. A back-lit LCD screen shows the frequency down to 10Hz resolution and an array of status indicators clearly display what receiver functions are being used. New features include: User-programmable tuning steps, 50 tunable memories (which store frequency, mode and filter setting), sharp IF filters for improved SSB reception, a special memory group scanning mode and IF bandwidth selection by mode. Features such conveniences as twin 12/24 hour clocks, a programmable on/off timer and 16 pre-programmed international shortwave bands, while an SSB carrier offset function allows you to customise the receiver's audio performance. It comes complete with detailed instructions and a DC cable for connection to an external power supply.

NEW! ***Two Year Warranty!*** Cat D-2790 **$999**



SANGEAN

Compact 45-Memory Shortwave Receiver

Tuning In The Easy Way!

The super compact ATS-606 makes finding your favourite shortwave (and local) stations as easy as pushing a button. Let it scan through the bands for you or, with the new Auto Tuning system, it will locate and put the nine strongest signals on both the AM and FM bands into memory. You can also key in a station's frequency directly from the keypad or put up to 45 frequencies into memory for instant push-button access. It gives continuous shortwave coverage from 1.715-29.995MHz, and 13 international SW band divisions can be directly accessed . You also get a dual alarm clock, sleep timer, dual time settings so you can pre-set any two-time-zones, DX/local switch which allows you to set the sensitivity to suit differing conditions, and a lock switch to prevent accidentally changing stations. Comes with stereo earphones for FM stereo operation and has an antenna socket for connection of an external antenna.

Cat D-2847 **$249**

PHILIPS

Dual Conversion AE 3405 Receiver

Tune into this Pocket-sized 12-band dual conversion receiver that offers both AM and FM reception as well as 9 international SW bands. It features volume and tone control and a tuning LED indicator that clearly displays the band you're currently tuned into. A hold function prevents the current station from being accidentally interrupted by making all the other buttons inoperative and a there's both a telescopic aerial for shortwave and an inbuilt aerial for AM/MW and LW/TB. It can be either battery (2 x AA) or mains operated and a stereo headphone socket is supplied for personal listening. Comes complete with protective carry case and a shortwave hand-book. Cat D-2856

NEW! **$99.95**

NEW!

'Shortwave Listening Guide'

Cat B-2040

$29.95

The whole world's talking on shortwave radio and this book tells you how to listen in! It contains everything you need to know about shortwave; selecting the right shortwave radio, how reception conditions vary, how to operate a shortwave radio correctly, profiles of international stations and more!

Save $10!

'Passport To World Band Radio'

Cat B-2052

$29.95

Essential reading for anyone who's getting started with a shortwave receiver. It's the latest 1993 edition and it includes all the changes that have taken place in Europe and Russia. Provides you with all you want to know about what's on shortwave radio, the best and worst radios, how to get the most from your shortwave listening and more!

Save $7!

'World Radio TV Handbook 1993'

Cat B-2093

$32.95

The ultimate directory of international radio and television. Gives complete listings including frequencies, addresses, call signs, station identification and transmission times. There's even a special feature on how to convert local time against UTC.

'Receiving Antenna Handbook'

Cat B-2045

$39.95

A comprehensive and thorough guide to high performance receiving antennas from longwave through to shortwave. It contains nearly 200 pages covering everything you need to know on this topic such as; the basic theory behind all receiving antennas, special designs for indoor and limited space applications and getting a good ground connection at radio frequencies. Plus, it includes complete easy-to-follow instruction details for each antenna.

PROTECTION
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If you've ever been burgled, you'll know that the price of leaving your home unprotected is too high. That's why more and more householders are investing in home security. Let us help you protect your home and family with affordable, easy-to-install security devices and a huge range of accessories.

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Security is yours with this affordable system! It covers the average home and can be easily upgraded to suit your future requirements. Activated by a single key, it includes a passive infrared sensor (PIR) for area surveillance, five pairs of magnetic switches for use on doors and windows, plus a panic button, an external horn siren and plug in power supply. You can install it yourself using the easy to follow step-by-step instructions supplied.
Cat L-5142 **$229**

Deluxe Security System

Affordable do-it-yourself security for the average-sized home. The pack includes a digital control panel with 4 user-selectable sectors and optional battery back-up in case of power failure. Plus it has a siren, infrared detector, door and window sensors plus 'panic' button. *(Not illustrated)*
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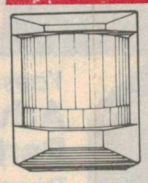
The Complete Home Security Pack

Everything you need to protect your home! It includes: 4-sector controller, two passive infrared detectors, two magnetic reed switches, emergency button, high-pitched internal siren, external horn speaker and cover, flashing strobe, 100 metres of cable, battery and mains power plug pack and deterrent stickers. Complete with easy-to-follow instructions.
Cat L-5150 **$599**

• ACCESSORIES • For Future Security Expansion!



Reliable Motion Detector

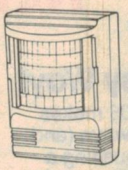
Fewer Annoying False Alarms!

A highly-sensitive infrared motion detector that's suitable for most alarm systems, it can be wall, ceiling or corner mounted. Protecting an area 12m x 12m with 110°, it utilises two pulse technology for greater accuracy and fewer false alarms. Has tamper protection and operates on 12V DC.
Cat L-5005 **$69.95**

Ness 'Ten' Passive Infrared Detector

They Won't Spot This Alarm!

The NES 'Ten' PIR can be mounted on the wall, ceiling or in the corner and, because of its compact size, it's unobtrusive. It covers an arc of 100° with an adjustable range of up to 15 metres and requires a supply of 9-16V. It's easily fitted to most alarm systems and offers tamper protection.
Cat L-5004 **$89.95**



Jaguar 3-Pulse PIR

For More Reliable Protection!

Featuring extremely reliable 3-pulse technology. It gives 140° coverage with an adjustable range of up to 12 metres making it ideal for large area protection in rooms and hallways. Can be mounted on walls or in corners, and is easily wired into virtually any alarm system. Operates from 9-16 volts DC and comes with tamper protection.
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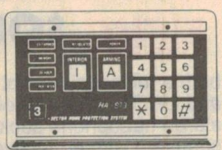
3 Sector Alarm Panel

Protect Up To Three Rooms!



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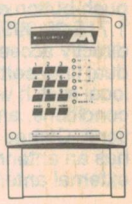
Cat L-5143 **$99**

4-Sector Alarm Panel

Professional Quality Alarm Panel



Multiguard 4 is suitable for both home and commercial premises. It's designed for maximum flexibility and ease of operation. With 4 individually controllable sectors, home and away capability (so you can leave perimeter sensors on while you're at home), audible entry/exit warning, 24 hour fire/smoke detector sector, optional battery back-up, full LED status report and more.
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Super-Loud Siren

Speaker horn with inbuilt driver which can be mounted externally and suits most alarm systems. Sounds an ear-piercing siren that's sure to attract attention. 12V operation.
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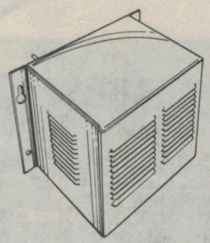
$34.95

Horn Cover
Protection For Your Siren!



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Shines Some Light On The Situation!

Bright flashing lights which can be mounted outside. When the alarm system is triggered it becomes instantly obvious where the alarm is coming from. Suit most alarm systems and operate on 12V DC.
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Don't risk messing about with conventional lead-acid batteries for indoor applications. These gel cells require no maintenance, are leak proof and can be either trickle or fast charged.

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100 x 55 x 45mm
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12V 6.5Ah
151mm x 96 x 65mm
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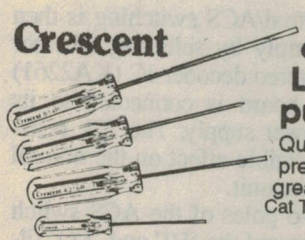
Crescent



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Quality 4-piece set of screwdrivers with precision-ground sand-blasted tips for greater accuracy.
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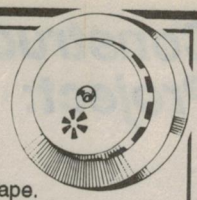
Every Home Should Have One!



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A magnetic switch used in windows and doors. Comes in plastic case for easy mounting and can be wired to any alarm with an N.C. circuit.
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Reed Switch
With both N.O and N.C contacts. It's encased for easy mounting and double-sided tape and screws are provided.
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Ideal for wood doors or windows, they can be recessed making them undetectable. Suitable for any alarm with N.C circuit.
Cat L-5212
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Ideal for protecting alarm panels and siren covers.
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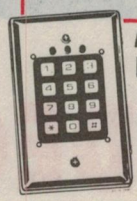

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A digital keypad with raised keys that can be fitted to alarm systems. It comes with a mounting block and is finished in brushed stainless steel and fitted with a tamper switch for added security.
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Construction Project:

IMPROVED DECODER FOR ACS SIGNALS - 2

In this second article describing a new and improved decoder for ACS signals, the author explains exactly how to fit his decoder module into a readily-available low cost AM/FM stereo radio/cassette unit: the Digitor A-5235, sold via Dick Smith Electronics stores.

by BOB PARKER

The Digitor AM/FM radio plus cassette unit was selected as a good example for ACS modification on the basis of its low cost, ready availability, reasonable internal roominess, and compatible stereo FM receiver — which has an adequate discriminator level of ACS subcarriers.

Once modified its ACS performance is quite good, so if you feel like using one of these machines to get into the world of ACS listening, read on. But remember: in gaining an ACS demodulator, your nice new ghetto blaster will probably lose its warranty!

As you can see from Fig.6, a certain amount of skulduggery was required to interface the Digitor's circuitry and the ACS demodulator. I felt that a single 'OFF/67kHz/92kHz' ACS control switch was best suited to this particular unit, and an examination of the Digitor's circuitry indicated that connection of the ACS board could be simplified by using a slightly unconventional approach.

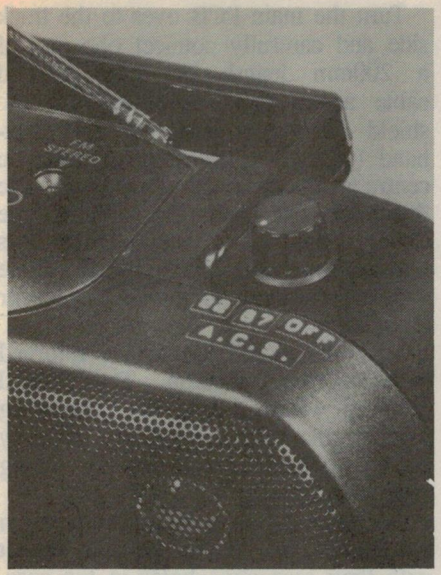
Instead of switching the audio signals to the volume pots, the output of the ACS board is permanently applied to the 'hot' end of each volume pot via fixed 22k resistors. Normal/ACS switching is then performed simply by selecting whether the existing stereo decoder IC (KA2261) or the ACS board is connected to its respective power supply. The 22k resistors have negligible effect on the normal operation of the unit.

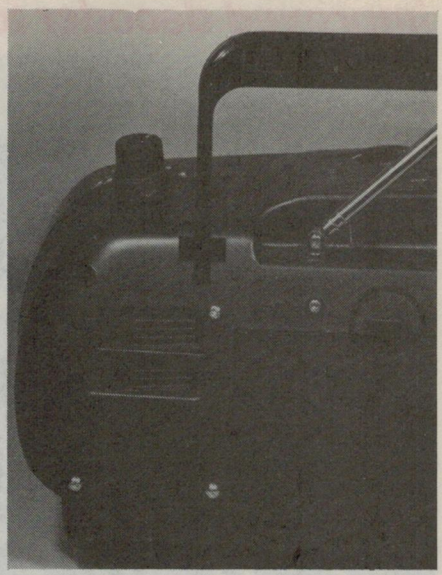
The last two poles of the ACS switch are used to ground the 'HI' and 'LO' filter control pins of the ACS board in the 92kHz position, for subcarrier frequency selection.

Case disassembly

Step one in making the conversion is to remove the rear moulding of the Digitor, which includes the AC power supply, battery compartment and whip antenna.

Take your trusty Phillips-head screwdriver and remove the four recessed screws near the corners, marked by little adjacent '>' pointers, then care-





Here are two close up photos of the Digitor A-5325 radio/cassette unit, with the ACS decoder fitted. At left is a top view showing the control knob for the switch used to select either normal FM reception or one of the two ACS sub-carriers. Fig.1 at right is a rear view showing the three small mounting screws which pass through the back of the case and are used to support the decoder module.

fully separate the back of the unit from the rest.

Look inside to the base of the telescopic antenna, and note how the wire to the main circuit board is attached, then remove the rear panel screw marked 'ANT>' and detach the wire with its lug.

Now warm up your soldering iron, and after noting which pins they go back to, unsolder the wires from the power supply board on the right-hand side below the power transformer. This will allow the separation of the rear case from the front.

Mounting preparations

Using the photos in Figs.1 and 2 as a guide, and the ACS board itself as a template, carefully mark out the mounting hole positions on the inside of the rear moulding, using a suitable pointed instrument. Due to the curved surface, only three screws can be used. Make the holes first using a small drill, then a 3.5mm (or 1/8") one.

Next the switch; once again referring to Figs.1 and 2, mark a position midway between the mounting screw pillar and the handle mounting, and about 15mm in from the front edge. After double- checking, drill a small hole followed by a suitably-sized one for the switch shaft. You might need a reamer, which should be used cautiously because the plastic is quite soft.

EXTRA PARTS FOR CONVERTING THE DIGITOR A-5235

3 x 20mm screws, 3 x 3mm nuts, 3 x 12mm spacers; 2 x 22k 0.25W resistors; approximately 1m of hookup wire; approx. 500mm of light shielded wire; 4-pole, 3 position rotary switch, with suitable small knob.

Main board removal

You may as well get the hard part over and done with first — which involves removing the main PCB. Start by noting where the 'AM/FM', 'RADIO/OFF-TAPE' and 'VOLUME' knobs all belong, then using fingernails under their edges, gently prise them out and put them to one side. Next unstick one end of the tape retaining the electret microphone.

Stage two is to remove the five black screws retaining the PCB; there's one near each corner, plus one about 55mm in from the left-hand edge and half-way down. Then, to put the tuning knob linkage in the least troublesome position, align the dial pointer with '6' on the bottom 'log' scale.

Now gently lift the bottom of the main PCB and pull it downwards, which will disengage the stereo LED and headphone socket from the top of the case. Take care not to disturb the tuning knob, which stays with the case front, and don't put excess tension on the wires between the board and the front section.

Discriminator cable

On the main PCB, locate the 100pF discriminator audio filter capacitor which is about 57mm in from the left-hand edge, and 25mm up from the bottom edge.

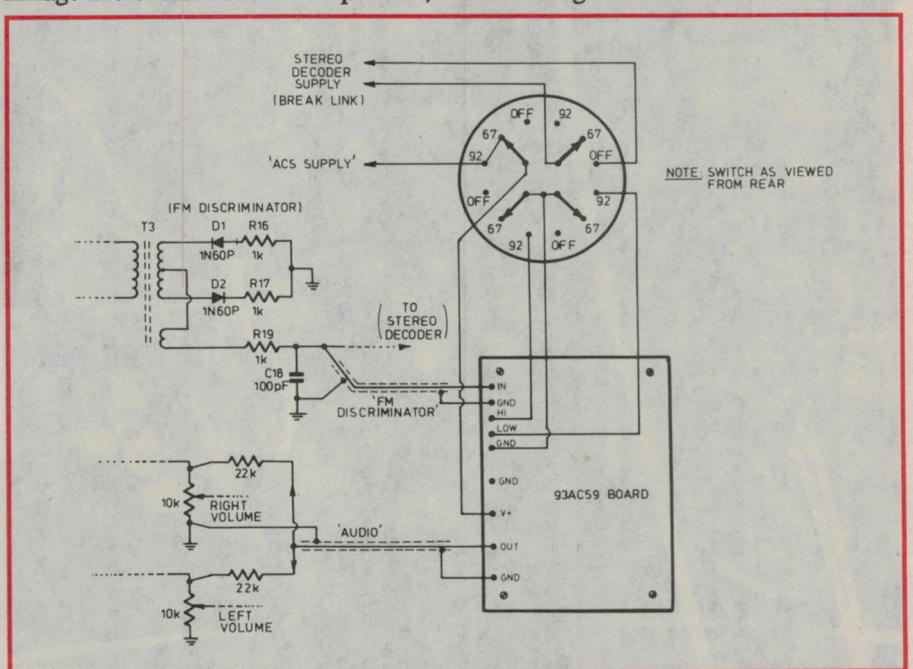


Fig.6: Details of the way the ACS decoder board is connected into the circuitry of the Digitor unit. The decoder input is taken from the junction of resistor R19 and capacitor C18 in the Digitor's FM discriminator.

Improved decoder for ACS signals - 2

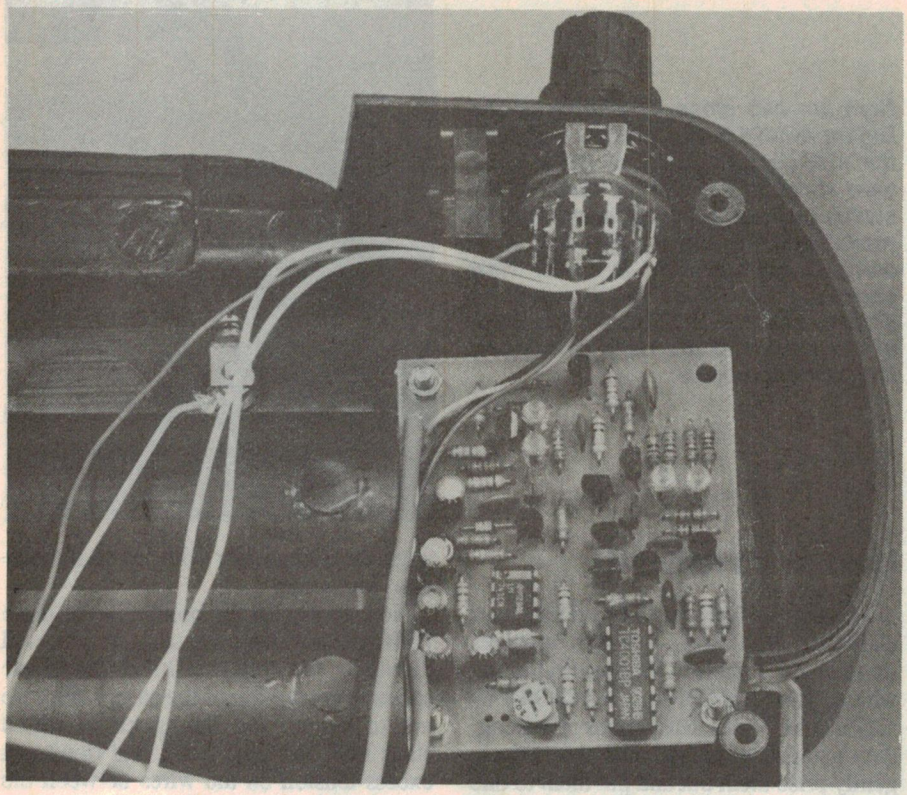


Fig 2: An interior close up showing the way the control switch and the decoder board are mounted at the rear of the right-hand speaker cavity. Some of the wiring between the two is also visible.

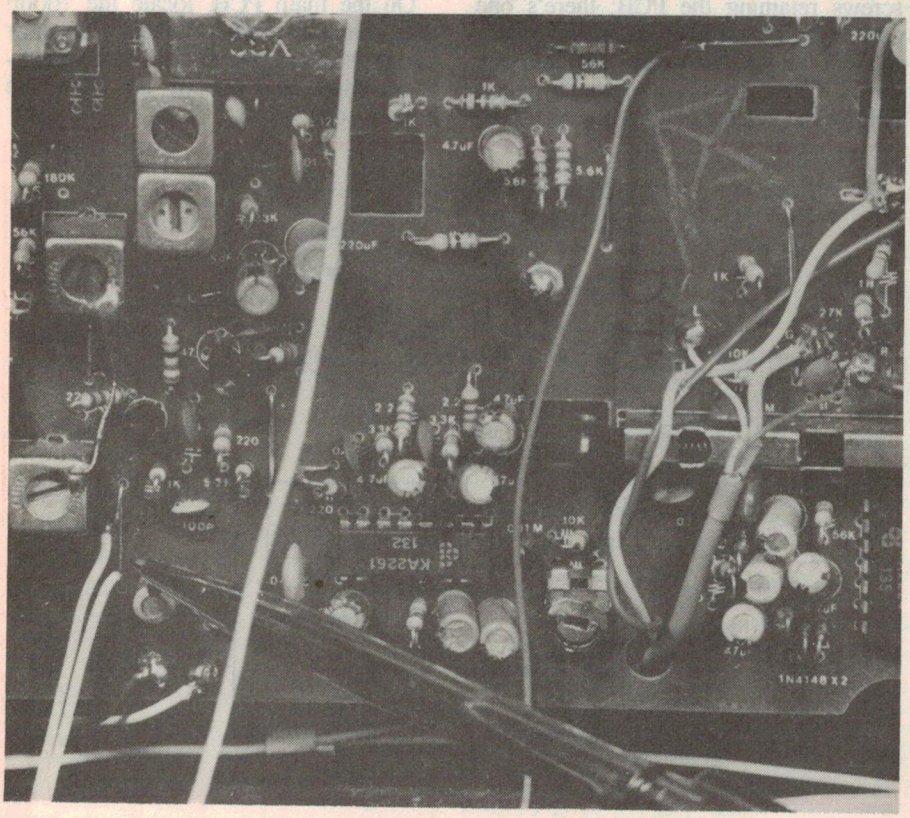


Fig.3: Another interior view, this time showing where the link on the main PCB which supplies DC to the stereo decoder section is cut, and the wires leading to the new control switch soldered to the two separated ends.

Turn the main PCB over to the track side and carefully connect one end of a 200mm length of thin shielded cable across this capacitor, with the shield conductor going to the right-hand (ground) capacitor lead, and the centre conductor to the other. Then route this cable out under the bottom edge of the board, below the capacitor. This will be the 'DISCRIMINATOR' cable shown connecting to the ACS decoder input in Fig.6.

Now the board has to be returned to its normal position. The crucial thing to watch is that the connecting pins on the tuning knob are properly engaged with the slots on the tuning capacitor coupling.

Once this condition is achieved, align the stereo LED and headphone socket with their respective holes in the case, and gently slide the PCB back into its correct position. Then re-install the PCB mounting screws, with the small one at the top left corner. Next stick the electret microphone back in its normal position and return the control knobs to their switches and pots.

Stereo switching

Referring to the photo of Fig.3, cut the centre of the vertical wire link just to the left of the discriminator audio filter capacitor, then bend up the cut ends perpendicular to the board. Obtain two 200mm lengths of hookup wire and solder one end of each to each of the link 'stumps', routing these wires, like all the rest, towards where the ACS board will live. The two you've just fitted become the 'DECODER' leads shown in Fig.6.

ACS power feed

Now, using Fig.4 as a guide, solder one end of a 270mm length of hookup wire to the horizontal wire link near the bottom right-hand corner of the 'Radio-Off/Tape' switch, as shown. This becomes the 'ACS SUPPLY' lead shown in Fig.6.

Audio output

After carefully studying Fig.5, find and tin the left-hand end 'hot' lugs of both volume pots, plus the accessible ground lug of the right channel pot on its lower edge, near its right-hand end.

Obtaining a pair of 22k 0.25W resistors, solder one lead of each to the left-hand lug of each volume pot, then solder the free resistor leads together in mid-air, above the right-hand end of the right channel pot.

Now solder the shield conductor of a 300mm length of thin shielded cable to the ground lug of the right

channel volume pot, and the centre conductor to the junction of the resistors. This becomes the 'AUDIO' cable shown in Fig.6.

Wiring it all up

Referring to Fig.6 yet again, terminate the two shielded cables you've just finished attaching to the main PCB, onto their respective pins on the ACS board. Now using suitable short lengths of hookup wire, connect the ACS board 'HI', 'LOW', 'GND' and 'V+' pins to the appropriate points on the four-pole three-position ACS rotary switch. Then connect the 'ACS SUPPLY' and 'DECODER' wires to their correct points on the switch.

Board, switch mounting

As shown in Fig.2 and using three 12mm tubular spacers, three 3 x 20mm screws and three 3mm nuts, mount the ACS board in its new home — but only do the screws up fairly loosely, so as not to warp the ACS board. Then install the rotary switch, doing up the mounting nut with a suitable spanner and being careful not to scratch the case.

Now's the time to finally do the big test and see if it all works! After thoroughly checking that all wires are in their correct places and that nothing is shorting, reconnect the unit's power leads to their correct terminals on the rear case power supply board and temporarily attach a length of wire to the antenna lead.

Turn the ACS switch to the 'OFF' position and first check that the radio still works normally. (If not, backtrack and correct whatever you've disturbed.) Then refer to the section in the first article on trying it out, and assuming everything works out OK, you can finally put it all together. (Don't forget to adjust the trimpot on the decoder board, so that the 'Normal' and 'ACS' audio levels are the same.)

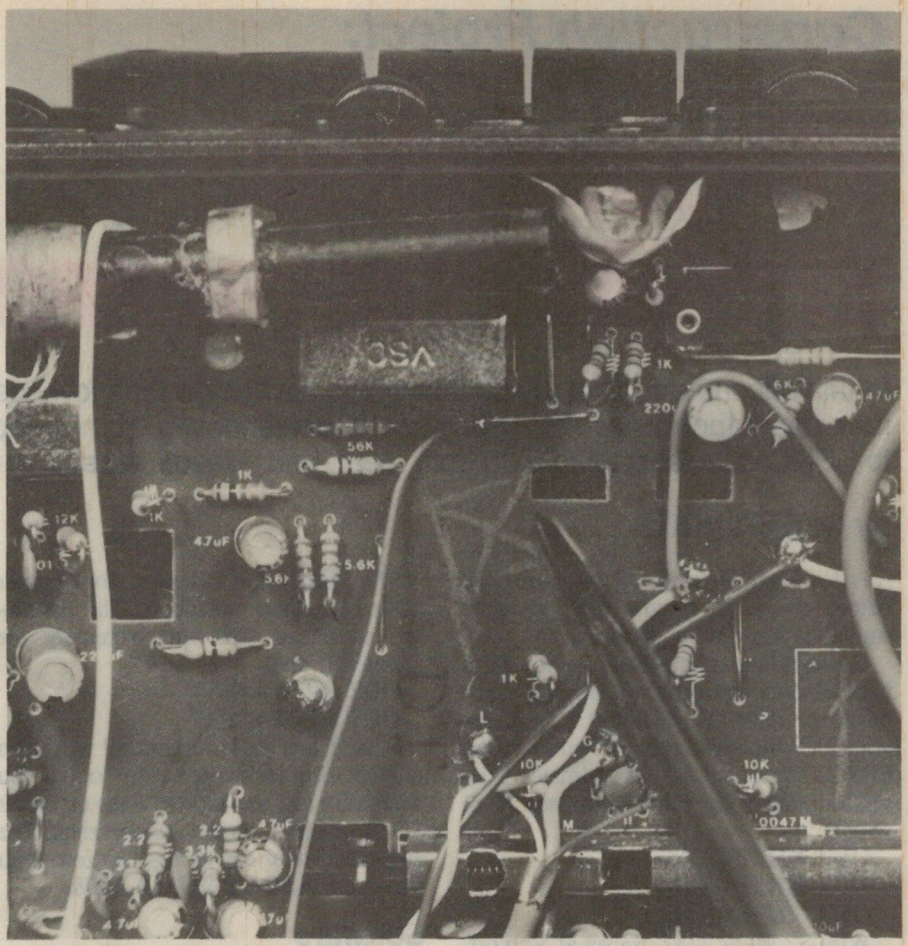


Fig.4: The DC supply for the ACS decoder itself is derived by soldering the 'ACS supply' lead to the horizontal wire link near the top centre of the main board, just below the Tape/Radio slide switch. The link is indicated by the pen.

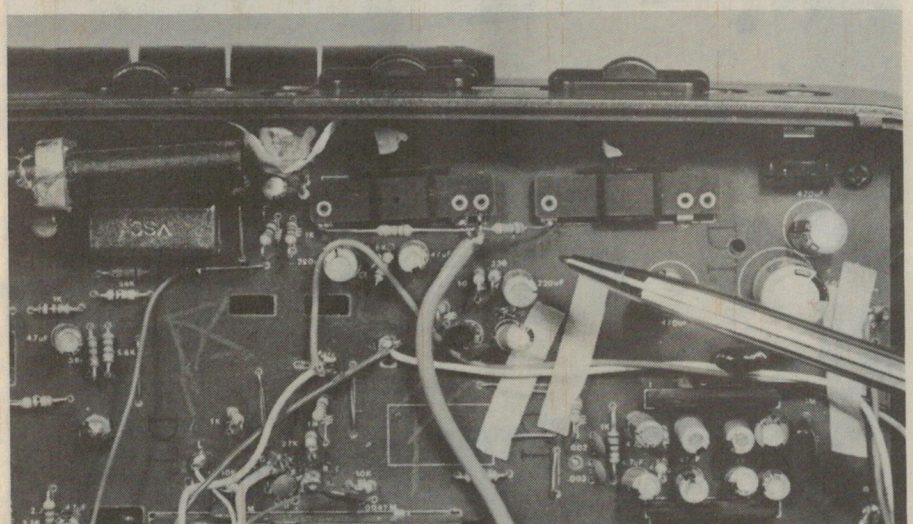


Fig.5: Here the pen is pointing to the two 22k resistors used to feed the audio from the ACS decoder module into the top end of each volume control pot. Note that the cable earth braid connects to the earthy end of the pot on the left.

After performing a final visual inspection and confirming that everything's alright, re-attach the antenna lead to the antenna base and then re-attach the rear case to the front part, making sure none of the wires are left hanging outside the case.

Finale

If everything's OK up to this point, all you need to do now is mount a suitable knob on the switch shaft, then put some appropriate labelling on the case so you know what you're listening to. I used black Dymo tape, but for a more professional appearance you could try using white rub-down lettering with a light coat of clear lacquer/enamel.

Don't forget to put the ACS switch in the 'OFF' position when listening to the AM radio or tape player.

That's about it. Your Digitor radio/cassette unit should now be capable of receiving any ACS signals currently being broadcast, so happy listening!

Next month, in the third of these articles, I understand Jim Rowe will be describing how to fit my decoder into a small Tandy AM/FM radio. ❖

Construction Project:

PC-controlled EPROM Programmer - 2

In this second and final article describing his design for a low cost PC-controlled EPROM programmer, the author discusses testing and troubleshooting, some simple BASIC software for writing data to EPROMs and reading data from them, and general aspects of using the programmer.

by GLENN PURE

A few simple tests can be performed before using the programmer, to make sure all is functioning properly.

Connect the programmer to the PC's parallel port and power it up, but don't insert an EPROM yet. Start BASIC on your PC and then test the pins on the EPROM sockets with a multimeter, after sending the following commands from your PC:

OUT &H378,&H0
OUT &H37A,&H8
OUT &H37A,&H3

With S2 set at 2732, S3 set at Vpp off, S4 on 27256 and S5 on 5V, the pin voltages with respect to the ground pin on both sockets should be low — except SOC2 pin 1, which should be around 4.5V, the Vcc pins of the two sockets which will be at 5V, and pin 22 of SOC2 which will be at logic high. All indicator LEDs should be off.

Send 'AA' hex to the data bus with the following command:

OUT &H378,&HAA

Indicator LEDs for D1, D3, D5 and D7 should come on, and the corresponding data pins on both sockets (SOC1 pins 10, 13, 15 and 17; SOC2 pins 12, 15, 17, 19) should go high.

Switch Vpp to 12.5V, 21V and 25V, testing SOC1 pin 20 and SOC2 pin 1 each time for the correct Vpp voltage. Then leave Vpp set on 21V and switch Vcc to 5/6V. Check SOC1 pin 24 and SOC2 pin 28 for 6V.

Send the following commands:

OUT &H378,&H0
OUT &H37A,&HD

SOC1 pin 24 and SOC2 pin 28 should now be 5V. Vpp should also be off, so that SOC1 pin 20 is now low and SOC2 pin 1 is at logic high. Set the 28-pin socket select switch to 64/128K. SOC1 pin 18 should be high, and SOC2 pins 20 and 27 high. Pin 22 of SOC2 should be low.

The final test checks for proper address counter operation. The following command pair will increment the counter by one:

OUT &H37A,&H4
OUT &H37A,&H5

Repeat the above command a known number of times (write a short loop if you wish) and test the address lines on either SOC1 or SOC2 for the correct result. The address counter can be reset to zero with the command **OUT &H37A,&H8.**

Software

The software for the programmer is simple BASIC code and can be run on machines with either *GW-BASIC* or the newer *Q-BASIC* shipped with MS-DOS 5.0. Note that the software runs slower in *Q-BASIC*, so if you have a choice, use *GW-BASIC*. I also recommend running the software while a minimum of other applications are running on your PC, to avoid contention for the same RAM area used by the programmer software. For example, I would not recommend attempting to start BASIC and the programmer software from inside *Windows*.

Some other applications might also be able to interrupt the programmer software, while it is running and interfere with the timing of write operations.

Two software listings are provided with the project: one for programming EPROMs and EEPROMs, and the other for reading them. The software listings contain plenty of comments, so I will only discuss some key aspects.

Note that the listing provided for the programming software actually should be entered as two separate files — one for EPROM programming and one for EEPROM programming. The bolded lines in the listing starting with

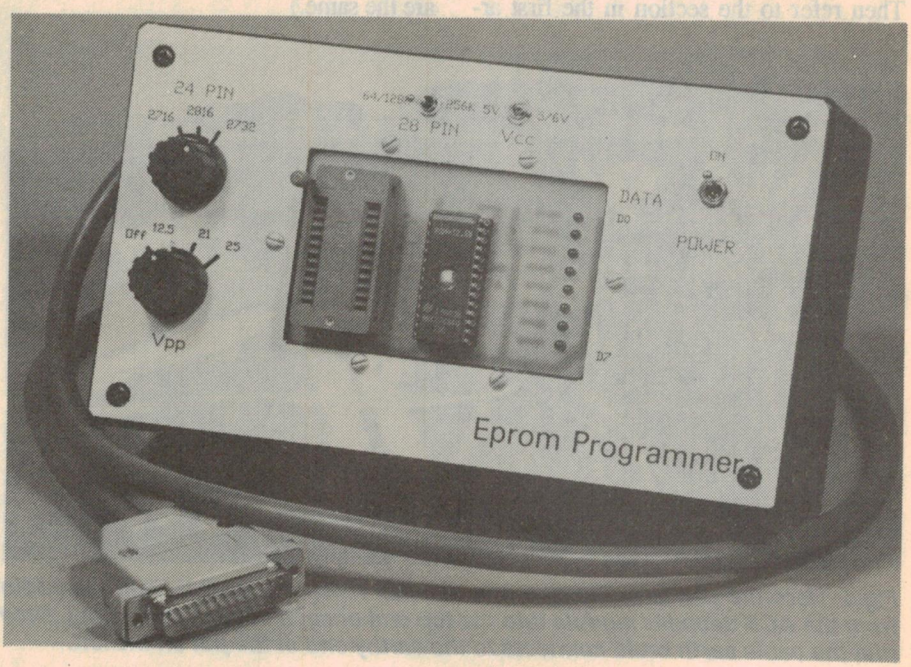


Table 5
Port 379hex and 37Ahex bit assignments

Parallel Pin	Address:Bit	Inverted?
11	379:7	Yes
12	379:5	No
13	379:4	No
15	379:3	No
10*	379:6	No
1	37A:0	Yes
14	37A:1	Yes
16	37A:2	No
17	37A:3	Yes

*Not used by programmer, but must be grounded. Remaining bits of address 379 are held high by the PC.

'EEPROM' provide instructions for the simple modifications to the software for use with EEPROMs. The readback software is useable with either EPROMs or EEPROMs.

First the programming software. The Def Seg statement in line 50 defines the memory segment in the PC which provides the source of the bytes to be written to the PROM. There is no strong reason for using this RAM area, and no reason why the segment can't be changed — but you will need to be careful not to use a part of the PC's RAM that is currently being used by DOS, BASIC or some other function.

One of the most critical parts of the software is the timing control, the key parts of which are found in lines 100-180. Accurately timed signals are required for the programmer during the write operation. I have written the software such that this timing is independent of the processor type or clock speed in your computer. The strategy used was to time how long the computer takes to execute a known number of repeats of a mathematical routine (the exact nature of which is not important).

Time was measured using the 'Timer' command in BASIC, which gives an accuracy down to 0.01 seconds. The timer is read immediately before the start of the time-wasting loop (lines 110-140) and immediately after it is completed to give the elapsed time.

It is relatively simple to calculate the integer value of the number of repeats required to give 50 milliseconds (or any other time) from the above information. The latter calculation is performed in line 180.

Some tailoring of the above master timing section will be required depending on the speed of your PC. You might need to change both the time-wasting mathematical routine in line 130 (or delete it all together) and the number of repeats of this loop (line 110).

Execution of an empty loop still takes time, but much less, and might prove useful for especially slow PCs or for generating short time periods. The aim is get an accurate timing, without sitting around for ages while the computer goes through this loop. I would suggest a few seconds for execution of this loop would be plenty.

The other very important consideration is the final number of loop repeats (VPLOOP, line 180) required to give the desired write pulse time (50ms, 10ms or whatever). Most EPROM data sheets I have looked at specify timing accuracy for write pulses of 5 - 10%. Simple mathematics therefore dictates that the number of loop repeats required to give such accuracy is a minimum of 20, if the 5% figure is to be achieved, i.e., the final value VPLOOP should be 20 or greater.

Changing the mathematical time waster in line 130 may be necessary to achieve this. The value of VPLOOP on your system can be checked easily by adding an extra line to the program:

185 PRINT "VPLOOP = "; VPLOOP

It is important to understand how the sending of control signals from the PC and receipt of data from the programmer is controlled by the software. As noted in the circuit overview given in the first article, there are three addresses which form the parallel port (Table 1).

The I/O address assignments shown are for the standard IBM compatible configuration for LPT1. Some PCs may have LPT1 set up differently and if this is the case, there will be a need to change the programmer software accordingly. If in doubt, test the programmer with the troubleshooting protocols described earlier.

Two BASIC commands are used to access these input and output addresses: 'Out' and 'Inp'. The individual pins which make up the parallel port represent specific bits of each I/O address. The data bus, address 378hex, is simple. Parallel pin 2 is bit 0 (D0) of address 378, pin 3 is bit 1 and so on to pin 9, which is bit 7 (D7). A byte sent to this address appears in the same form on the parallel port output pins.

Addresses 379 and 37A are more complex, since they only use only five bits and four bits respectively of the byte and, in some cases, invert bits before inputting or outputting them. The bit allocations and whether inversion occurs is shown in Table 5. Obviously, this information is essential for determining how to interpret data input to the PC through address 379, or to select the correct byte to output to address 37A to produce the desired control status in the programmer.

Table 6 is derived from Table 5 and shows the bytes that should be output to address 37A to achieve selected control conditions in the programmer.

DANGER!

Experimenting with EPROMs usually means working with short wave (254nm) UV lamps, for erasure. At risk of repeating what you might already know, these lamps are dangerous. You should avoid exposure at all times. Purpose built EPROM erasers are designed with this in mind, but home made erasers may involve exposed UV tubes. So beware!
Short wave UV damages the genetic material (DNA) in your skin and can result in skin cancer in the long term. It is also very harmful to eyes, and can result in short term acute damage as well as blindness in later life.

Table 6
Programmer Control Command Summary

Byte (hex)	Address Counter Clock inp	Vpp on/off; Vcc volts	Output Enable*	Chip Enable	Address Counter reset	Function
05 to 04 to 05	H to L to H	Vpp off; Vcc 5 V	L	L	L	Addr. Counter advance (during read)
08	L	Vpp off; Vcc 5 V	H	H	H	Addr. Counter reset
05	H	Vpp off; Vcc 5 V	L	L	L	Read
01	H	Vpp off; Vcc 5 V	H	L	L	EEPROM write
0B	H	Vpp on; Vcc 6 V	H	H	L	Program standby
03	H	Vpp on; Vcc 6 V	H	L	L	EPROM Program
07	H	Vpp on: Vcc 6 V	L	L	L	EPROM Program verify
07 to 06 to 07	H to L to H	Vpp on: Vcc 6 V	L	L	L	Counter advance (during programming

* PGM line is inverse of OE line

EPROM.BAS (EPROM/EEPROM write program)

```
10 REM Clear screen, initialise key variables, define memory source
20 CLS
30 WRERROR=0
40 NONFF=0
50 DEF SEG = &H8000
60 REM Set Programmer to "read" mode
70 OUT &H37A,&H5
80 PRINT "Adjusting Programmer Pulse Timing    Please wait....."
90 REM Measure elapsed time with a time wasting loop
100 T1=TIMER
110 FOR N=1 TO 10000
120 TWASTE=909
130 TWASTE=SQR(TWASTE^3)-22
140 NEXT N
150 T2=TIMER
160 REM This section calculates loop cycles equivalent to 50msec
EEPROM: In line 160 change 50msec to 10msec
170 TELAP=T2-T1
180 VPLOOP=INT(10000/(TELAP*20))
EEPROM: In line 180, change 20 to 100
190 BEEP
200 INPUT "Number of bytes to load (use &h prefix for hex numbers)"; COUNT
210 INPUT "Starting address location"; ADDRSTART
EEPROM: Delete lines 220-460 inclusive
220 REM Check EPROM for target bytes initialised (set to FF)
230 REM First zero address counter
240 OUT &H37A,&H8
250 OUT &H37A,&H5
260 REM Set address counter to starting address
270 IF ADDRSTART=0 GOTO 330
280 FOR I=1 TO ADDRSTART
290 OUT &H37A,&H4
300 OUT &H37A,&H5
310 NEXT I
320 REM Check each target EPROM location
330 FOR I=(ADDRSTART+1) TO (COUNT+ADDRSTART)
340 OUT &H378,&H0
350 CHK1=INP (&H379)
360 OUT &H378,&H1
370 CHK2=INP (&H379)
380 CHK=CHK1+CHK2
390 IF CHK=126 GOTO 430
400 REM NONFF is incremented each time a location does not return FF
410 NONFF=NONFF+1
420 REM Advance address counter & check next location
430 OUT &H37A,&H4
440 OUT &H37A,&H5
450 NEXT I
460 PRINT "Eprom checked:" NONFF "Locations NOT set to FFhex"
470 PRINT "Do not proceed unless data loaded into memory"
480 PRINT "Data should be loaded starting at address 8000:0 using 'DEBUG'"
490 PRINT ""
500 PRINT "IF PROCEEDING, TURN Vpp TO CORRECT VOLTAGE NOW"
EEPROM Change line 500 quote to "TURN Vpp OFF"
510 PRINT "CHECK OTHER PROGRAMMER SWITCHES FOR CORRECT SETTING"
520 INPUT "Do you wish to proceed y/n"; Q$
530 IF Q$="n" THEN END
540 IF Q$="N" THEN END
550 PRINT ""
560 PRINT "CTRL-BREAK TO ABORT"
570 REM Reset address counter
580 OUT &H37A,&H8
590 OUT &H37A,&H5
600 REM Loop to read data and write to Eprom
610 REM Set address counter to starting address
620 IF ADDRSTART=0 GOTO 670
630 FOR I=1 TO ADDRSTART
640 OUT &H37A,&H4
650 OUT &H37A,&H5
660 NEXT I
670 FOR I=(ADDRSTART+1) TO (COUNT+ADDRSTART)
680 REM Turn Vpp on, then send data to programmer
690 OUT &H37A,&HB
EEPROM: Delete lines 680 & 690
700 BYTE=PEEK(I-1)
710 OUT &H378,BYTE
720 REM Send "write" instruction to control lines of programmer
730 OUT &H37A,&H3
EEPROM: Change line 730 to OUT &H37A,&H1
EEPROM: Add new line 735 OUT &H37A,&H5
740 REM Loop to waste time for [10msec (EEPROM) or] 50msec (EPROM)
750 FOR N=1 TO VPLOOP
760 TWASTE=909
770 TWASTE=SQR(TWASTE^3)-22
780 NEXT N
790 REM Read the data just written and compare to original
800 OUT &H37A,&H5
810 RDBACK=0
820 REM Set D0 to 1 to read lower nibble
830 OUT &H378,&H1
840 FOR NIBBLE=1 TO 2
850 B=INP (&H379)
860 REM Convert input data
870 IF B=135 THEN D=0:GOTO 1050
880 IF B=7 THEN D=1:GOTO 1050
890 IF B=167 THEN D=2:GOTO 1050
900 IF B=39 THEN D=3:GOTO 1050
910 IF B=151 THEN D=4:GOTO 1050
920 IF B=23 THEN D=5:GOTO 1050
930 IF B=183 THEN D=6:GOTO 1050
940 IF B=55 THEN D=7:GOTO 1050
950 IF B=143 THEN D=8:GOTO 1050
960 IF B=15 THEN D=9:GOTO 1050
970 IF B=175 THEN D=10:GOTO 1050
980 IF B=47 THEN D=11:GOTO 1050
990 IF B=159 THEN D=12:GOTO 1050
1000 IF B=31 THEN D=13:GOTO 1050
1010 IF B=191 THEN D=14:GOTO 1050
1020 IF B=63 THEN D=15:GOTO 1050
1030 GOTO 1110
1040 REM Combine two nibbles
1050 RDBACK=RDBACK+(D*16^(NIBBLE-1))
1060 REM Send 0 to D0 to read upper nibble and repeat loop above
1070 OUT &H378,&H0
1080 NEXT NIBBLE
1090 IF RDBACK=BYTE GOTO 1120
1100 REM Execution here only if error in byte written: increment error counter
1110 WRERROR=WRERROR+1
1120 REM Continue here error or no error: Advance address counter
1130 OUT &H37A,&H4
1140 OUT &H37A,&H5
1150 LOCATE 13,1
1160 PRINT (I-ADDRSTART) "BYTES WRITTEN"
1170 NEXT I
1180 BEEP
1190 PRINT WRERROR "Errors in bytes written"
1200 PRINT ""
1210 PRINT "TURN Vpp OFF NOW"
EEPROM: Delete line 1210
1220 REM Zero address counter
1230 OUT &H37A,&H8
1240 OUT &H37A,&H5
1250 PRINT "Address counter zeroed"
1260 ADDRESS=0
1270 LOCATE 17,1
1280 PRINT "Display contents of address" ADDRESS; "on programmer LEDS y/n"
1290 Q$=INPUT$(1)
1300 IF Q$="n" THEN END
1310 IF Q$="N" THEN END
1320 OUT &H37A,&H4
1330 OUT &H37A,&H5
1340 ADDRESS=ADDRESS+1
1350 GOTO 1270
1360 END
```

Note that the write protocol for EEPROMs is slightly different to that for EPROMs. For the SEEQ EEPROMs, the write cycle commences by sending PGM low (while CE is low). This latches the target address into the device.

Sending PGM high then latches the byte to be written into the device and actually commences the write operation within the EEPROM. So the write operation actually occurs when the EEPROM is in read mode. It is still necessary to wait for the EEPROM's internal timer to finish the write cycle before attempting any further manipulations to the EEPROM.

In the case of the readback program, the principles and much of the code is the same as that for the program verify com-

EPRMREAD.BAS (EPROM/EEPROM readback program)

```
10 REM Clear screen, define memory source/target
20 CLS
30 DEF SEG = &H8000
40 REM Set Programmer to "read" mode
50 OUT &H37A,&H5
60 PRINT "TURN Vpp OFF/CHECK PROGRAMMER SWITCHES FOR CORRECT SETTING"
70 INPUT "Number of bytes to read (use &h prefix for hex numbers)"; COUNT
80 INPUT "Starting address location"; ADDRSTART
90 REM Zero address counter
100 OUT &H37A,&H8
110 OUT &H37A,&H5
120 REM Set address counter to starting address
130 IF ADDRSTART=0 GOTO 180
140 FOR I=1 TO ADDRSTART
150 OUT &H37A,&H4
160 OUT &H37A,&H5
170 NEXT I
180 INPUT "Compare EPROM data to PC RAM (1) or write to RAM (2)"; Q
190 IF Q=1 GOTO 230
200 IF Q=2 GOTO 480
210 PRINT "Exiting"
220 GOTO 999
230 PRINT "Do not proceed unless data loaded into memory"
240 PRINT "Data should be loaded starting at address 8000:0 using 'DEBUG'"
250 PRINT ""
260 INPUT "Do you wish to proceed y/n"; Q$
270 PRINT ""
280 IF Q$="n" THEN END
290 IF Q$="N" THEN END
300 PRINT "CTRL-BREAK TO ABORT"
310 REM SECTION COMPARES EPROM TO PC RAM
320 REM Read data from PC RAM
330 FOR I=(ADDRSTART+1) TO (COUNT+ADDRSTART)
340 BYTE=PEEK(I-1)
350 REM Call subroutine to read the EPROM
360 GOSUB 1000
370 REM Compare data with RAM
380 IF RDBACK=BYTE GOTO 410
390 REM Execution here only if mismatch detected
400 PRINT "Error at location (hex) " HEX$(I-1) " wrong data " HEX$(RDBACK)
410 REM Continue here error or no error: Advance address counter
420 OUT &H37A,&H4
430 OUT &H37A,&H5
440 NEXT I
450 BEEP
460 PRINT "All Bytes checked"
470 GOTO 999
480 REM SECTION TO WRITE EPROM DATA TO PC RAM
490 PRINT "CTRL-BREAK TO ABORT"
500 REM Start read loop, call EPROM read subroutine
510 FOR I=(ADDRSTART+1) TO (COUNT+ADDRSTART)
520 REM Call Subroutine to read EPROM
530 GOSUB 1000
540 REM Write to RAM, start offset 0 irrespective of EPROM read start address
550 POKE (I-(ADDRSTART+1)),(RDBACK)
560 REM Advance address counter
570 OUT &H37A,&H4
580 OUT &H37A,&H5
590 NEXT I
600 PRINT "All locations read"
610 BEEP
620 INPUT "Write to file y/n"; Q$
630 IF Q$="y" GOTO 660
640 IF Q$="Y" GOTO 660
650 GOTO 999
660 LINE INPUT "File path and name? ";F$
670 BSAVE F$,0,COUNT
680 PRINT ""
690 PRINT "WARNING:"
700 PRINT "SAVE OPERATION ADDS 7 SYSTEM (ID) BYTES TO START OF FILE"
999 END
1000 REM SUBROUTINE FOR READING CURRENT EPROM ADDRESS
1010 RDBACK=0
1020 REM Set D0 to 1 to read lower nibble
1030 OUT &H378,&H1
1040 FOR NIBBLE=1 TO 2
1050 B=INP (&H379)
1060 REM Convert input data
1070 IF B=135 THEN D=0:GOTO 1250
1080 IF B=7 THEN D=1:GOTO 1250
1090 IF B=167 THEN D=2:GOTO 1250
1100 IF B=39 THEN D=3:GOTO 1250
1110 IF B=151 THEN D=4:GOTO 1250
1120 IF B=23 THEN D=5:GOTO 1250
1130 IF B=183 THEN D=6:GOTO 1250
1140 IF B=55 THEN D=7:GOTO 1250
1150 IF B=143 THEN D=8:GOTO 1250
1160 IF B=15 THEN D=9:GOTO 1250
1170 IF B=175 THEN D=10:GOTO 1250
1180 IF B=47 THEN D=11:GOTO 1250
1190 IF B=159 THEN D=12:GOTO 1250
1200 IF B=31 THEN D=13:GOTO 1250
1210 IF B=191 THEN D=14:GOTO 1250
1220 IF B=63 THEN D=15:GOTO 1250
1230 PRINT "Illegal Value returned... Exiting"
1240 RETURN 999
1250 REM Combine two nibbles
1260 RDBACK=RDBACK+(D*16^(NIBBLE-1))
1270 REM Send 0 to D0 to read upper nibble and repeat loop above
1280 OUT &H378,&H0
1290 NEXT NIBBLE
1300 RETURN
```

ponents of the EPROM write software. However, unlike the EPROM write software, there are two options for readback. One is the same as the verify operation in the write software, and compares the EPROM contents with the data in the PC's RAM.

The other is to write the EPROM contents to RAM — again using RAM segment 8000hex as the target. The latter option also includes a provision for writing the results to a file for permanent storage. Any path name and file can be entered. Note, however, that the BASIC command used to write the file appends seven bytes to its start, to identify size and other parameters.

One final comment about the software before making a few remarks about using the programmer. As already noted, the software provided for writing data to EPROMs is suitable only for devices requiring a single 50ms write pulse for each byte written.

Devices requiring multiple short write pulses at each address location with a verify operation following each can be handled by the hardware, but I am not providing software for this here.

One of the reasons is that BASIC is not a very suitable language for it. Being a high level language, BASIC runs slowly and operations such as performing multiple verify operations for each byte can take far longer than the actual write operation itself. Nevertheless, in trials on my 33MHz 386, the operation does work and runs at least as fast as the old 50ms programming protocol.

I hope to write some better software for the programmer in a more efficient language, but haven't done this yet and am not sure when I'll get to it. So please don't let my intentions discourage anyone else from having a go!

Using the programmer

A programming session is initiated by first loading into the PC's RAM the data to be written to the EPROM. This is easily achieved using Debug, which is a utility provided with DOS (detailed instructions for using debug can be found in your DOS manual).

Typing the following commands will start debug, load a file starting at RAM location 8000:00hex and then quit back to the DOS prompt:

Debug drive:\path\filename <enter>
L8000:00 <enter>
Q <enter>

Now, start BASIC and load the desired programmer software. Connect the programmer to the parallel port and insert the EPROM/EEPROM, but do not switch its power on yet. First, set the Vpp switch to 'off' to reduce the risk of an accidental 'write' during power up, and set the remaining switches on the programmer as necessary.

Start the software, switch the programmer on and simply follow the prompts from here!

There is one small caution. If you try and run a printer or other device from the parallel port after a session with the EPROM programmer, the printer may not work properly as it checks the logic levels on the parallel port control lines — which have been changed during your EPROM programming session. I therefore advise rebooting the PC after a session with the programmer.

Don't forget to switch off the programmer power before removing or inserting PROMs.

Happy experimenting!❖

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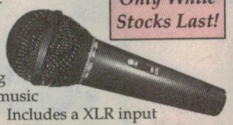

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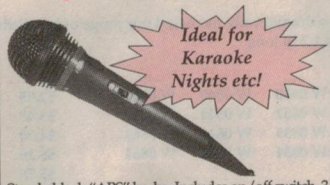

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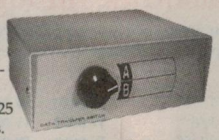

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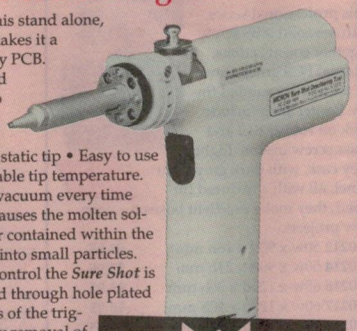

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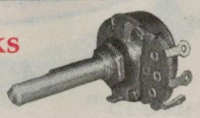

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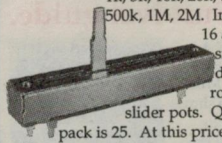

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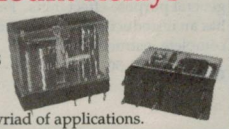

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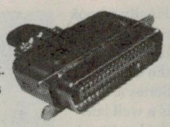

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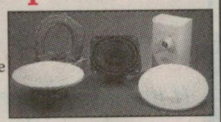

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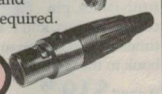
C 0988 Normally $99.00,

This Month Only $79.95

Mini XLR Connectors

NEW

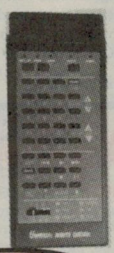
Just arrived into stock is a new range of miniature 3 pin XLR connectors. The outside diameter of the male is only 10mm. Ideal for audio projects where a small and reliable connection is required.



Ideal for Those Miniature Audio Projects!

P 0890	Inline Female	$3.15
P 0892	Inline Male	$3.15
P 0891	Chassis Mount Male	$3.90
P 0893	Chassis Mount Female	$4.15

Universal Remote Control



This Universal Remote Control makes all other remotes superfluous. Designed to combine all infra red remote controls into one handy unit. No more searching through piles of remotes.

A 1000 Normally $69.95

This Month Only $55.00

Hurry - Only While Stocks Last!

Thermalloy TO–3 Heatsink

Includes threaded studs to secure transistors. Thermal resistance 7°C/W. Ideal for all those projects with TO-3 transistors.

H 0503 Normally $1.20

This Month Only .50¢ ea

Hurry - Only While Stocks Last!

VU Panel Meters

These quality meters are ideal for amplifier projects or replacement units. MU45 quality class 2.5.

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The Pin Point Ultrasonic Cleaner uses a transducer generator to produce millions of activated microscopic cleansing bubbles which blow dirt, grease and grime off surfaces, and penetrate deep into cracks and holes. This personal ultrasonic cleaner won't scratch precious jewellry or glass. Tank size 150 x 90 x 55mm approx.

A 0100 Normally $229.00

This Month Only $209.00

100mm Super Carbon Fibre Speakers

Fantastic for Cars, Boats, Homes etc.

These amazing little speakers will impress you and your friends. Carbon fibre is a new high tech material from which these speaker cones are made. Complimented with Barium Ferrite Magnets the results are simply amazing. 16 ohm coils make these units ideal for multi-speaker installations a breeze. Weatherproof design means they are fantastic for cars, boats, homes etc.

C 0643 Normally $39.95

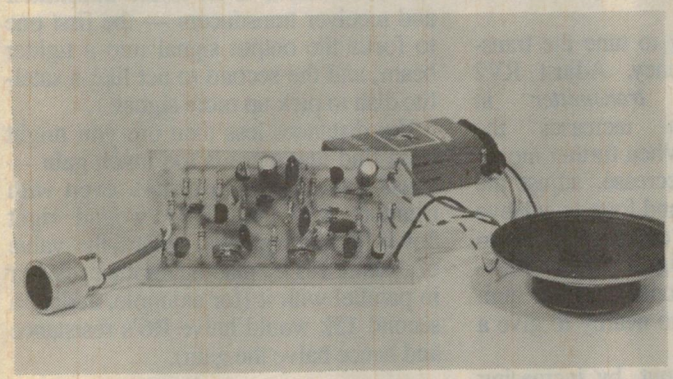
This Month Only $25.00 ea, or $40.00 Pair

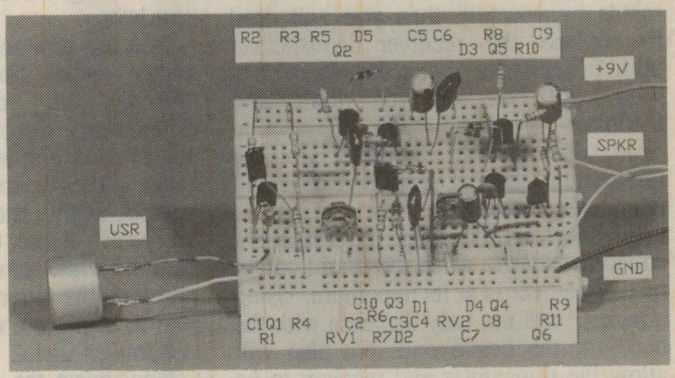
Experimenting with Electronics

by PETER MURTAGH

Ultrasonic messages — 2

Last month we showed you how to combine a voice signal with the output of a 40kHz ultrasonic transducer, using amplitude modulation (AM). So this month — logically — we will show how to recover that audio signal. The circuit that we will use is very similar to the mediumwave and shortwave receivers featured in recent projects.





Left: Like last month's ultrasonic transmitter, the receiver is also joined to the PCB with a short length of shielded cable. This allows easy alignment to maximise the signal being received. Right: Here's the layout for breadboard construction. (Refer to the schematic for more details if all connections are not clear.)

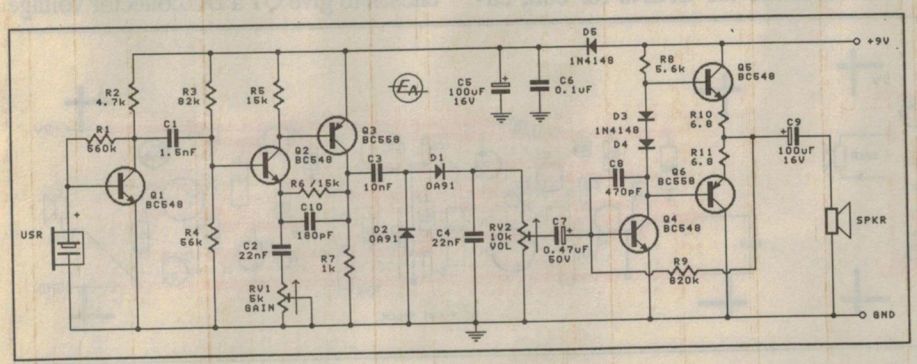
To capture any of the many signals which criss-cross the ether around us, we need a sensor which can resonate at the frequency of that particular signal.

Our ultrasonic transducer does just this — it resonates for sound waves at 40kHz; so it can pick up any such high frequency sound wave beamed out by our transmitter, and convert it into a 40kHz electrical signal. From this point on in the circuit, our receiver is just like any AM radio.

Because all our ultrasonic transmissions occur at 40kHz, we have no need for a tuning circuit. It's really like a one-station radio receiver! Also, like radio, the signal picked up is very small, and so we must first amplify it considerably before it can be used (like our radio's RF amplifier).

Next we detect the signal, using germanium diodes, to remove the audio from the carrier, filter off the carrier, and then amplify the remaining signal so that it can drive a small 8-ohm speaker. That's all there is to this month's circuit!

As we mentioned last month, it is better to use a separate power supply (battery) for the receiver, so that the transmitter cannot interfere with it, through fluctuations in the supply voltage. We must take this precaution, since our receiver includes several stages of amplification — with quite high overall gain.



The schematic shows the two main sections of the receiver circuit: on the left is the ultrasonic signal amplifier and AM detector (centre); while on the right is the push-pull class AB audio amplifier.

Construction

Construction is quite straightforward. Begin in the usual way with the more rugged components, working your way through resistors, capacitors, diodes and transistors.

Refer to Fig.3 for the orientation of the polarised components. When you come to mount the ultrasonic receiver (USR), either connect it directly to pins on the PCB, or use a short length of shielded cable to give more flexibility. You should find it easier to point both transmitter and receiver transducers directly at each other if you use cable connections.

Remember too, that the transducer is a polarised component — connect the terminal which is not part of the casing to the '+' connection. (A quick inspection of the base of the transducer will show one terminal joined to the case and one insulated from it.)

Trimpot RV2 on last month's *transmit-*

ter circuit is used to maximise its output. It adjusts the oscillator frequency so that that output is at exactly the resonant frequency of the nominal 40kHz transducer. The transducer works with maximum efficiency at this resonant frequency.

All in all, there are four trimpots — two on the transmitter and two on the receiver — which can be adjusted. Start with all of them in approximately centre position. Note that there is an RV1 and RV2 on each circuit — so note whether it is the transmitter or receiver that we are talking about, when these abbreviations are used.

If you intend to make the adjustments by yourself, then you will need to replace the receiver loudspeaker with headphones — preferably with a long lead! This way you won't have feedback problems with the sound from the speaker returning to the microphone, getting amplified over and over, and howling.

Or alternatively, enlist the help of a friend to indicate when the sound output of the receiver is at its maximum. Using a partner will not only dispense with the need for the headphones but also will allow the transmitter and receiver to be placed a lot further apart.

Now, set up the transmitter and receiver (say 3m apart), with the two transducers aligned to face each other exactly. If the signal produced by the speaker is clear and undistorted, you can move on to tune the output frequency of the transmitter. However, if the signal is distorted, then correct it before proceeding.

Such distortion can be caused either by over-modulation in the *transmitter*, or by over-amplification in the *receiver* in either the carrier or the audio stage. Rather than trying to locate the exact source of the distortion — and there could be more than one source — turn down all three trimpots by the equal amounts until the output signal is clean. At this stage, don't worry about maximising the output — you can do that later.

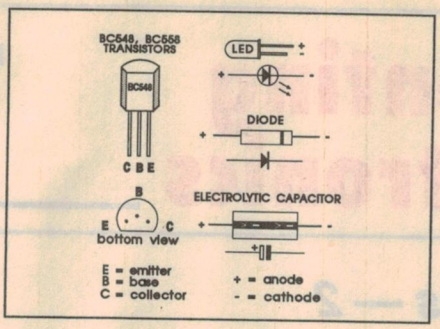


Fig.3: Refer to this diagram to identify the various leads of the polarised components used in the circuit.

You are now ready to tune the transmitter output frequency. Adjust RV2 (FREQ) on the *transmitter* in whichever direction increases the loudspeaker output. When further movement causes it to decrease, adjust the trimpot slightly back and forth to achieve the peak volume. Of course, this has to be done while some signal is being picked up by the microphone. Speak or hum into it, or place a radio nearby to give a continuous signal.

Now boost the output, by increasing the GAINs and VOL trimpots. Work systematically through RV1 on the transmitter, then RV1 and RV2 on the receiver. Turn each trimpot up until distortion occurs, then back it off slightly. Note that once the RV1 GAIN is correctly set on the transmitter, it shouldn't need to be altered again — provided, of course, that you don't change the microphone signal level.

However, you will need to adjust the RV1 GAIN on the receiver whenever the distance between the transmitter and receiver is changed. Otherwise, reducing the distance will cause distortion, and increasing it will make the output volume in the speaker too low. As a general rule, first maximise the GAINs for both circuits, then adjust the receiver VOL for comfortable listening.

Also, you should not operate the VOL setting at its maximum level, because some resistance in series between diode D1 and capacitor C7 is needed for the negative feedback via resistor R9 to be effective. Without this feedback the speaker output will distort.

Changes

The main change that you can make is to find the greatest distance over which your transmission can operate. We found that reception worked well even at 6m. Can you better this distance?

You certainly could if you built two cardboard horns to fit to the transmitter and receiver transducers — the first one to focus the output signal into a tighter beam, and the second to act like a satellite dish to pick up more signal.

For distances less than 6m you might even find that there is too much gain — causing the signal to distort, even with trimpots RV1 and RV2 wound right down. If this happens, reduce the value of resistor R6 by placing another resistor in parallel with it (for example, adding a second 15k would halve R6's resistance and hence halve the gain).

How it works

The ultrasonic transducers contain a ceramic piezo-electric element which resonates at around 40kHz. A piezo-electric effect occurs when the application of an alternating electric field produces, through resonance, elastic vibrations in a crystal. These vibrations are transferred to the surrounding air molecules as sound waves. (This happens in the transmitter — of course in the receiver the process is reversed.)

The tiny electrical signal generated by the receiver transducer is amplified by stage 1 of the amplifier. Transistor Q1 is set up as a single-stage, common emitter amplifier. The 4.7k value of R2 has been chosen to give Q1 a DC collector voltage

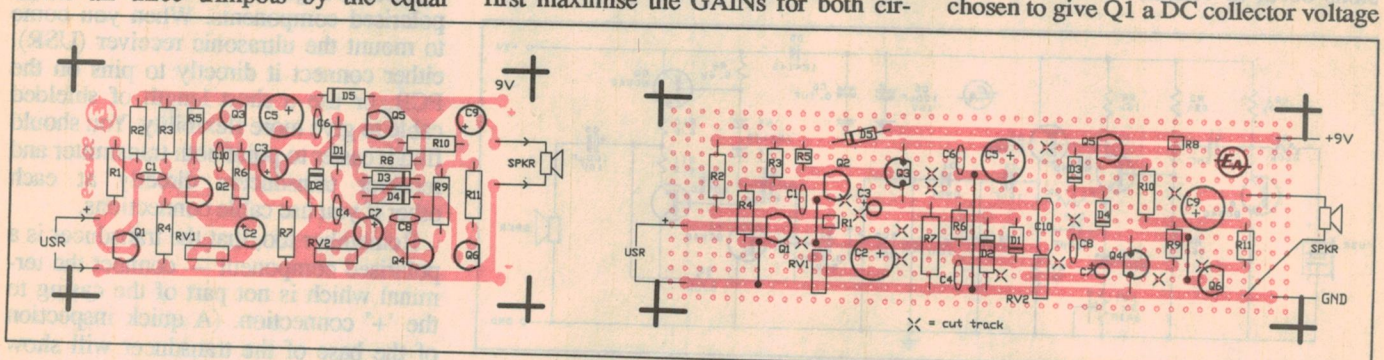


Fig.1 (left): The component layout for the PCB. It differs slightly from the prototype as shown in the photo — isolating diode D5 was a later addition. Note that Q3 and Q6 are the two PNP transistors. Fig.2 (right): If you build this stripboard version of the ultrasonic receiver, remember to break the copper tracks at all points marked with an 'X'.

of 4.5V (half the supply voltage) and a quiescent collector current (which is the steady DC current through the transistor when there is no AC input) of 1mA (0.001A). This value is calculated using Ohm's law:

$R = V/I$
$= 4.5V/0.001A$
$= 4.5k$

and 4.7k is the nearest preferred resistor value.

A similar calculation gives the 560k value of R1. The specifications for a BC548 transistor tell us that the gain can be anywhere between 110 - 800. Let's take a conservative value and choose 150 as being a typical gain (so that our circuit will work for just about any BC548 transistor that anyone might come by). So, if the collector current is 1mA, then the base current will be:

$I_B = I_C/gain$
$= 0.001A/150$
$= 0.0000067A$
$= 6.7uA$

Remember too that there is a voltage drop of 0.65V across the base-emitter junction of Q1, hence the voltage drop across R1:

$V = 4.5 - 0.65 = 3.85V$ and
$R = V/I$
$= 3.85V/0.0000067A$
$= 575k$

and 560k is the nearest preferred value.

The advantage of connecting the right hand end of R1 (see the schematic diagram) to the junction of the Q1 collector and R2, rather than directly to the supply rail, is to provide negative feedback, and hence stability.

This setup works because any change in the current through R2 will automatically change the voltage drop across R1 in such a way that it causes transistor Q1 to compensate for the original change.

For example, if the current through R2 increases due to a temperature change, the voltage across R2 increases, causing the R1 voltage to decrease, and hence less base current to flow into the transistor. This results in Q1 decreasing its collector current, which neutralises the original current increase.

Further amplification of the signal occurs in the two-transistor amplifier (Q2 and Q3), which also uses negative feedback for stability. Unlike the first stage, this one features adjustable AC feedback, which gives us variable gain. The approximate gain — ignoring the impedance of capacitor C2 — equals R6/RV1 (the inverse of the feedback fraction).

The next section of the circuit is the 'voltage-doubling' detector circuit (germanium diodes D1 and D2) to extract the 'audio envelope'. The value of C4 has been chosen so that the capacitor stores the audio frequency fluctuations (it has a high impedance at low frequencies), but bypasses the carrier frequency to ground (with its low impedance at high frequencies).

If you require a more detailed explanation of how these stages of the circuit operate, refer back to recent issues of *EA*. The two-transistor amplifier is almost identical to the audio amplifier in last month's transmitter circuit; and the operation of the detector circuit was explained in the AM mediumwave radio circuit in May.

PARTS LIST

Miscellaneous

PCB 81 x 42mm, coded 93usr8
9V battery
ultrasonic receiver
8 ohm mini loudspeaker
hookup wire, solder, etc.

Resistors

All 1/4W, 5%

1	560k	R1	green-blue-yellow
1	4.7k	R2	yellow-purple-red
1	82k	R3	grey-red-orange
1	56k	R4	green-blue-orange
2	15k	R5,R6	brown-green-orange
1	1k	R7	brown-black-red
1	5.6k	R8	green-blue-red
1	820k	R9	grey-red-yellow
2	6.8	R10,R11	blue-grey-gold
1	5k 5mm vert.trimpot		RV1
1	10k 5mm vert.trimpot		RV2

Capacitors polyester (greencap)

1	1.5nF	C1
2	22nF	C2,C4
1	10nF	C3
1	0.1uF	C6

Capacitors PC-mount electrolytics

2	100uF,16V	C5,C9
1	0.47uF,50V	C7

Capacitors ceramic

1	470pF	C8
1	180pF	C10

Semiconductors

2	OA91 Ge signal diodes	D1,D2
3	1N4148 Si signal diodes	D3-D5
4	BC548 NPN transistors	Q1,Q2,Q4,Q5
2	BC558 PNP transistor	Q3,Q6

To further amplify the audio signal, we have chosen a different method to that used in our recent radio circuits. While the first stage is similar — voltage amplification is provided by transistor Q4 — we have added current amplification via transistors Q5 and Q6. The arrangement of these two transistors is a new one for this series — a class AB amplifier, with the two transistors acting in a push-pull configuration.

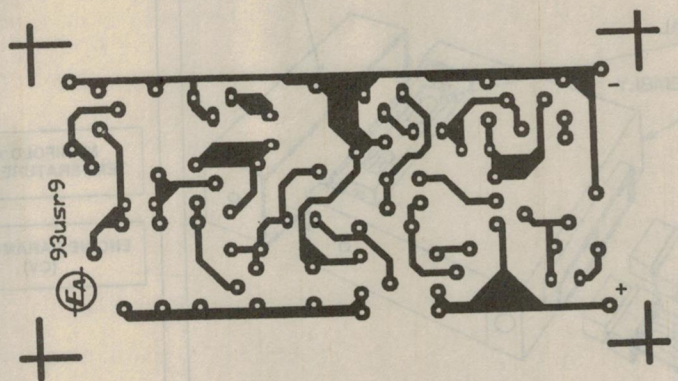
We will explain the operation of class AB amplifiers in more detail next month, but basically they remove the need for the large quiescent current which flows in a class A amplifier by using two separate transistors — an NPN to amplify the positive section of the signal and a PNP for the negative part. When there is no signal, the two transistors are not turned on, so there is no quiescent current. However, some base-emitter bias is applied so that it only takes the arrival of a small signal to complete the task of turning on the transistors.

In our circuit we have used diodes D3 and D4 in series to set the voltage drop between the two transistor bases. The forward bias of each of the two signal diodes D3 and D4 is about 0.6V, while that of the base-emitter junctions of transistors Q5 and Q6 is slightly higher at about 0.65V. Hence Q5 and Q6 are *almost* biased on, but not quite!

This setup results in a small amount of crossover distortion in our amplifier, as one transistor turns off before the other one turns on.

Notice also in the push-pull setup that the load is connected to the emitter of the transistor rather than the collector (as in the class A design). This arrangement is logically called an 'emitter-follower', and the collector is the common terminal for both the input and output. It provides

Continued on page 97



If you wish to etch your own board, then make use of this full size PCB pattern. Using a PCB design will give a far more stable circuit for high gain amplifiers than either the stripboard or breadboard construction.

AUTOMOTIVE ELECTRONICS

with MAJOR AL YOUNGER (USAR, Ret.)

GMH's C-3 Engine Management System

If you have a JD/JE Camira, VL EFI Commodore 'Group A', 1.6/1.8 litre Astra or V6/V8 VN Commodore that is not a badge change, you have this system. It's used on both TBI (throttle body injection) and PFI (port fuel injection) engines. This article will give you a basic rundown on how the system works.

The C-3 system has been around for quite a while. It's actually a fourth generation system, but as a GM engineer told me, "We can't call it the C-4 system — after all, Ford has a transmission called a C-4". So much for how 'Detroit' thinks.

Incidentally, talking about 'Detroit', I received a letter from an Aussie reader who wanted to know exactly where Detroit is located. Well, I use the term 'Detroit', for any US automotive manufacturer, regardless of their geographic location. Even in the USA, the term 'Detroit' is only used as a general symbol for US auto manufacturers, since most of them have more than one manufacturing facility, generally not located in Detroit.

The city of Detroit in Michigan is the home of General Motors, and it's known as 'Motor City'. Ford's headshed is Dearborn, also in Michigan. But many of the trucks and vans for Ford and Chrysler are made in Canada; in fact Ford's factory in Windsor, Canada is famous for the Ford Windsor (302/351) engines. Windsor is actually only a very short drive from Detroit Michigan, and many Canadians work in Detroit and commute.

But back to Australia and the GMH C-3 system. The Holden people made a wise choice when they selected this system, because it allows one ECU to fit all of the Australian manufactured Holdens. It's only necessary to change the Mem-cal (memory-calibration) unit (Fig.1).

The Mem-cal unit contains firmware that identifies the vehicle parameters — such as engine type, vehicle weight, axle ratio, transmission type and diagnostic data. It also contains operating and diagnostic instructions for that particular version of the C-3 system.

The C-3 controls the following:

- Air/fuel ratio (AFR)
- Timing
- Idle speed
- A/C clutch control
- Fuel pump operations
- Emissions
- Transmission lock-up
- 'Check engine' lamp (CEL)
- Radiator fan control
- Diagnostics (code & data stream)
- Trip computer
- Cruise control
- Anti-theft device

As you can see, it has plenty to do.

Overview

The ECU is located on the passenger side, behind the left hand cowl panel. The diagnostic connector on VN's is located behind the ECU. On other vehicles, it's under the dash panel near the glove box.

The ECU's central processor unit or 'CPU' is an eight-bit device that runs at a clock speed of 8.388MHz. It contains input/output conditioning circuits, solenoid/injector drivers, a reference voltage source (5V), an ignition control driver and RAM memory. The RAM monitors indicator circuits, sets codes and reads codes and provides data stream output, when requested. The inserted mem-cal adds ROM and PROM memory for vehicle information, processing of infor-

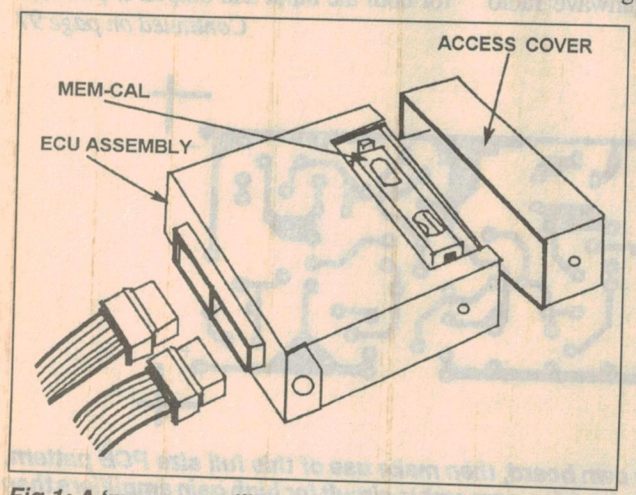


Fig.1: A 'memory calibration' unit is used to customise the C-3 system for each model of GMH vehicle.

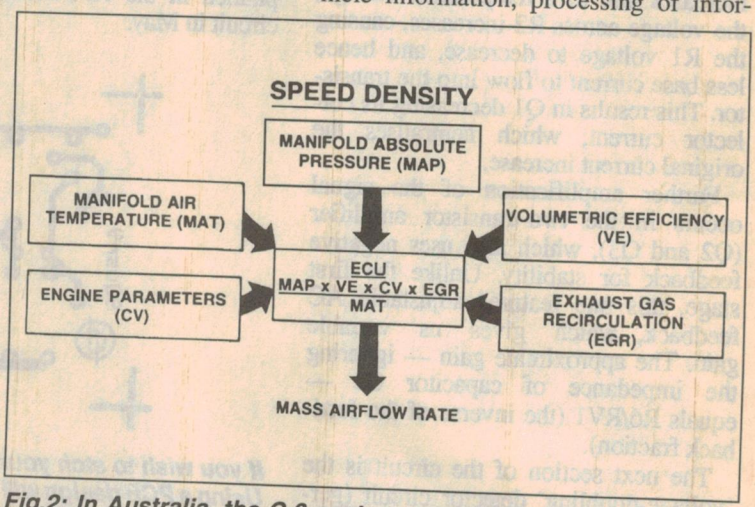


Fig.2: In Australia, the C-3 system uses the MAP speed density system for fuel control.

mation (inputs) and issuing of commands (outputs).

MAP Density System

The C-3 system in GM's Australian vehicles uses the speed or MAP Density system for fuel control (Fig.2). It has many advantages over AFC (Air Flow Control). It does not require a barometric pressure sensor for atmospheric compensation, as AFC does. In addition, MAP sensors cost much less than AFM (air flow meter) or MAF (mass air flow) sensors.

The MAP (manifold absolute pressure) sensor monitors both atmospheric pressure and engine vacuum (Fig.3). The absolute type fitted is unique in operation. When the engine is not running, the atmospheric pressure pushes against the diaphragm. When the ignition key is turned on, the ECU reads the MAP output, which represents atmospheric pressure. This data is stored in memory for fuel calculations.

After the ECU receives a signal (RPM) that the engine is running, it then reads the MAP output as vacuum. So if you're driving up a mountain and your engine starts running like the proverbial 'hairy goat', just shut the engine off and start it up again. The ECU will then get an updated and better reading for atmospheric pressure, and it will run properly again.

AFR control: The system will attempt to manage the AFR at the optimum ratio of 14.7:1, in all modes of operation. This happens even if there's no control signal from the O_2 sensor.

Ignition

The C-3 system allows the use of many different types of ignition system. Most of the GMH vehicles concerned are fitted with a HEI (high energy ignition) system, except the VN 3800 V6 which has a DFI (direct fire ignition) or distributor-less system.

In all cases, if the ECU fails to provide EST (electronic spark timing) or for any reason the system defaults, the ignition system runs the engine in the diagnostic or 'limp' mode. More about this subject soon, under diagnostics.

The ECU monitors all the sensors to determine the proper mode of engine operation. The modes then control the basic AFR requirements, as follows. Not that not all modes are available in all vehicles.

STARTING: The injector pulse width is determined by engine temperature. The system exits this mode at 300rpm.

BACKFIRE INHIBIT — WHILE CRANKING: Uses the 'crank' signal to shut off the injectors until 450rpm, to prevent backfires.

CLEAR FLOOD: Holds the injector pulse width to 8ms, until the engine starts. Conditions are with the accelerator 'floored' and engine revs below 300rpm.

RUN OPEN LOOP: This mode remains effective until the engine is at operating temperature, with the oxygen sensor working and the engine not at idle.

RUN CLOSED LOOP: Based on the signal from the oxygen sensor. Provides an injector signal for precise control of AFR at 14.7:1.

IDLE MODE: Applies when the throttle is closed with the vehicle speed less than 5kph. The oxygen sensor signal is ignored.

ACCELERATION: In this mode the ECU provides the engine with extra fuel. If the demand is great enough, it will add extra injector pulses.

DECELERATION: The ECU decreases injector pulse width to maintain idle.

DECEL FUEL CUTOFF: The injector pulses are cut off if the rpm is above 1500 or the vehicle speed is over 35kph.

BATTERY VOLTAGE CORRECTION: The injector dwell time or idle speed are increased if battery voltage is down.

FUEL CUTOFF: The injectors are shut off if the engine revs exceed 5400rpm or the vehicle speed is over 220kph.

Most of these modes should be self-explanatory, except perhaps for the Run Closed Loop. The conditions for this mode are (a) the engine at operating temperature; (b) the O_2 sensor heated by the exhaust, to 300°C; and (c) the sensor providing a signal output to the ECU.

To aid in the precise control of AFR, a 'block learn multiplier cell' method is used, as a fuel management program. This consists of 16 blocks of data (00 to 15), which represent RPM and IPW (injector pulse width in milliseconds) at the ideal combustion (AFR) ratio of 14.7:1, as the base. The cells each have a count of between 0 and 255, with 128 representing an AFR of 14.7:1.

To explain how 'block learn' works can be very complicated, so I will proceed in very layman-level terms. First, we must have a brief understanding of how the O_2 sensor operates.

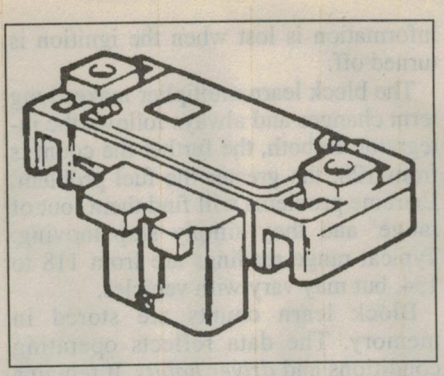


Fig.3: The C-3's MAP (manifold absolute pressure) sensor, which monitors both atmospheric pressure and engine vacuum.

Oxygen (O_2) sensor

The O_2 sensor monitors the exhaust gases for oxygen ions. It outputs a varying DC voltage of between 0 and 1V. If the exhaust O_2 content is high (lean condition), the voltage is low; conversely if the exhaust O_2 content is low (rich condition), the voltage is high.

This signal is sent to the ECU. The ECU then gives an opposite command to the injectors, to correct the situation. So if it receives a signal indicating a rich condition (high O_2 sensor voltage), it 'leans out' the injectors by changing (reducing) the IPW. If the signal should indicate lean (low voltage), and the ECU then enriches the system by increasing the IPW.

Now many people in the trade think the O_2 sensor voltages should be the other way around, with higher voltage meaning more oxygen. But you electronic blokes will understand, when you learn the O_2 sensor is referenced to outside oxygen, which far exceeds the oxygen content in the exhaust.

'Hunting' action

If you monitor the O_2 sensor output with a DMM or other high input impedance (10M or 20M) voltmeter, you should see it moving between about 0.2 and 0.8 of a volt. This action is referred to as 'hunting'. Just remember that this is due to the action of the ECU in changing the AFR, in its effort to maintain it at the optimum 14.7:1. The O_2 sensor does not switch its output by itself — it's only reacting to the changing oxygen content in the exhaust.

Some people get confused over the sensor's temperature-related switching characteristics. If the sensor is at 350°C it takes 100ms, while at 800°C it takes 50ms (including hysteresis). But just remember that the ECU controls the 'hunting'.

Of course if the O_2 sensor is faulty or it's not hot enough, there will *be* no 'hunting'.

(NOTE that Holdens do *not* have heated O_2 sensors. So to monitor O_2 sensor operation, it's necessary to run the engine at a fast idle of about 1800rpm. The exhaust gases will then heat the sensor to its operating temperature — 300°C or higher.)

So what we are trying to achieve is *stoichiometry* or optimum fuel burning, which is synonymous with an AFR of 14.7:1. This also corresponds to a count of 128 in one of our block learn multiplier cells, and also to an average O_2 sensor voltage of 0.45V. OK so far?

Block learn multiplier

The data in the block learn multiplier cells is generated after engine mapping at the factory. This is an extensive process of engine testing at different RPM's and load factors ('load' is the MAP sensor output data). This information is placed in each cell as pre-programmed fuel requirements, referenced to an AFR of 14.7:1 — i.e., a count of 128. So, in each cell, the count factor (128) and the IPW are known.

Which cell data is selected by the ECU is a function of RPM and load. For instance, cell 00 is idle at NOT (normal operating temperature) with say, an IPW of 2-3ms (milliseconds). Then say cell 11 is reached by a heavy load demand and a sharp rise in RPM. The IPW in cell 11 is say 9-11ms, to meet this demand at the ideal AFR, again a count of 128. The cell information is different for each vehicle configuration.

I hope this is not too confusing. Other systems use lookup tables to determine fuel requirements. Think of the information in the cells as the ideal fuel requirements, relative to an AFR of 14.7:1, and the starting point or fuel factor, for corrective calculations.

Fuel integrator

The fuel integrator counter monitors short term fuel correction and has no memory. It makes no changes in open loop and has a fixed count of 128. In contrast the 'block learn' counter makes long term fuel correction and has memory. Both counts may be monitored in the data stream output. Of course, this takes special equipment, like a hand scanner. Autotechs who understand integrator-block learn operation use this count information to diagnose difficult fuel problems.

In closed loop, the integrator reads the O_2 sensor output and makes any short term corrections. If the count goes below 128, it's making a correction for a rich condition, by lowering the IPW.

For diagnosis, just remember **higher counts are compensating for lean mixtures and low counts for rich mixtures**. Note that the integrator information is lost when the ignition is turned off.

The block learn multiplier makes long term changes and always follows the integrator. In both, the further the count is from 128, the greater the fuel problem. Extreme problems will find them 'out of range' and they simply stop moving. Typical range readings are from 118 to 134, but may vary with vehicles.

Block learn counts are stored in memory. The data reflects operating conditions and *driver habits*. It remains in memory for 25 engine cycles or until the continuous power source to the ECU is disrupted (like the battery being disconnected).

So what happens if there's a small fuel problem? Yes, it's stored in memory and the vehicle acts accordingly. Many a GMH vehicle has been fixed, simply by disconnecting the battery and starting 'relearn' over again (more about this shortly in diagnostics).

Remember, anything that effects AFR — such as a small vacuum leak, dirty air or fuel filter, timing not spot-on, etc., — effects the block learn multiplier method. (NOTE: The JD Camira systems do not use this method.)

Diagnostics

The C-3 system has built-in self diagnostics. If a key sensor fails, it attempts to FIX itself, by substituting a fixed value for the sensor's output. If this occurs the CEL will come on.

If the system cannot correct the problem in this way, it will default to the diagnostic mode, which is the 'limp mode'. In this mode the system runs on the ignition system with fixed timing.

An ALDL (assembly line diagnostic link) connector allows code and data stream retrieval from the ECU. On the VN Commodores there's a field service mode that allows testing O_2 sensor operations. (NOTE: The term 'ALCL', standing for 'assembly line communications link', is synonymous with ALDL.)

Data stream diagnosis of the C-3 system will not be discussed here, since it requires special equipment. Diagnosing using data stream is really the only way to go, but the equipment costs.

There's actually two types of code retrieval, one sent by the system automatically in response to a malfunction, and the other codes which must be requested by the autotech.

When the ignition is turned on, the ECU initially turns on the CEL. Then the little 'leprechaun' inside the ECU jumps on his electronic bike and does a quick tour of the system, gathering data along the way. If there's no malfunctions and the engine starts, he 'blows out' the CEL, by lifting its earth path. But if a malfunction is present, the CEL remains on and the leprechaun does an 'Irish jig' around it.

If a malfunction occurs when driving, the CEL will also come on. So if an autotech wishes to retrieve codes or do diagnostic testing, he simply earths the CEL path.

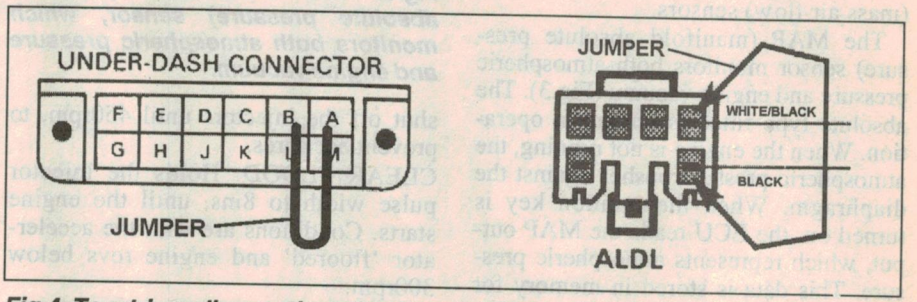


Fig.4: To retrieve diagnostic codes from the C-3 system, the technician earths the CEL path by bridging either the under-dash connector (left) or the ALDL connector (right) adjacent to the ECU.

ALDL bridging

For ALDL bridging, place a jumper in the connector (Fig.4a and b), then turn the ignition on. A code 12 (Pass) should flash on the CEL, and continue until the jumper is removed. A 12 is indicated by one flash, a pause, then two more flashes. Any fault code present will flash continuously if there is only one and three times each if there's more than one code.

When the ignition is turned on, some circuits energise:

Radiator fan relay
A/C control relay
Torque converter solenoid
IAC/ISC (fully extends)

If the engine is now started, the timing will be fixed at 10° BTDC (before top dead centre), idle will be controlled as a function of temperature, the relays/solenoid will remain energised and the CEL stays On. You are now in

the *diagnostic or limp mode*. No new codes may be logged into memory. If it's a VN Commodore, you are in the Field Service Mode.

If a problem is intermittent, the code will appear on the CEL, but will go out after 10 seconds. The code will stay in memory for 20 power-up cycles, or until cleared by power removal.

All faults indicated must be *fixed* and *cleared*. To clear, remove the 'eng comp' fusible link or disconnect the battery for 10 seconds. Then, retest and make sure you get a pass code 12.

If the ECU does not 'throw' you any code, you have deep troubles — possibly a bad ECU. But check all connectors, power and earth points on the ECU, before you condemn it.

Practical approach

Here's a down to earth, practical checklist for diagnosis and servicing of the GMH C-3 system 'by the numbers':

1. Place the jumper in the ALDL connector.
2. Read the codes and write them down.
3. Remove the jumper.
4. Disconnect power (fusible link/battery).
5. Start engine, run until HOT.
6. Do a few WOT's (wide open throttles).
7. Turn A/C on, then off.
8. Shut the engine down.
9. Replace the ALDL jumper.
10. Read codes, write them down.
11. Fix any faults.
12. Disconnect power (step 4).
13. Retest (steps 1 and 2).
14. Remove ALDL jumper.

If you can SAFELY raise the driving tires off the ground, it can be tested 'driving', albeit with a small load factor. If you have speedo, tripmeter or cruise control problems, this test will check the VSS (vehicle speed sensor) or road speed unit.

VN Field Service Mode: This test must follow the Key-on test with no fault codes present — i.e., you must have received a code 12 (Pass). This mode checks the ECU operation of fuel control, in open and closed loop operations. It can be used during a road test or stationary. Only the latter will be discussed.

The procedure is:

1. Place ALDL jumper.
2. Start the engine.
3. Set idle at 1800rpm (timing fixed at 10° before TDC).

And here's how to interpret the results:

A. Flashing open loop: the CEL will flash on and off 2.5 times per second (five times in two seconds).

B. Flashing closed loop, with fuel system operating normally: the CEL will flash on/off once per second.

C. Flashing closed loop, O_2 sensor indicates lean condition: the CEL will be *off*, all or most of the time.

D. Flashing closed loop, O_2 indicates rich condition: the CEL will be *on*, all or most of the time.

No diagnostic codes should be set during this field service mode test.

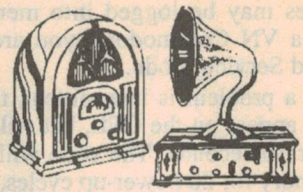
Summary

That's about all we have room for in this article. There's a lot more to know about the C-3 system than we have been able to cover here, of course. If you wish to get more detailed information, I can only suggest that you send for my GMH booklet for $60.00.

The following books are also still available: *The Ford EEC-IV* booklet ($60.00); *The Code Book* ($35.00); and *Maintaining the Electronic Motor Car* ($25.00). Send your orders to Major Al Younger, PO Box 477, Double Bay, NSW 2028. ❖

Vintage Radio

by PETER LANKSHEAR



Some popular output triodes — part 2

Right from the early days of broadcasting, large output triodes have been linked with high quality sound reproduction, and even today are in demand by a select group of enthusiasts — who are convinced that the triode is still unrivalled in providing the ultimate sound. In this second part of the story, we look at some of the 'second generation'.

Last month took us to 1929 and the arrival of the popular type 45 triode. In Holland, Philips research had in 1927, developed the very first of a promising new type of valve: the output pentode, which overcame two weaknesses of the triode — lack of sensitivity and inefficiency. Meanwhile, the trusty 45, generally operating in push-pull, continued to serve America well in the new generation of big mains powered receivers.

The Americans took until 1931 to produce what they considered to be satisfactory pentodes: the Arcturus PZ, followed by the similar RCA 47. With their greater power efficiency and higher amplification factor, the pentodes soon displaced the 45. The Great Depression restricted demand for expensive cabinets, and convenience and economy ensured the success of the 'midget' mantel receivers that took their place. With its greater sensitivity the pentode output valve was a natural choice for these new receivers, as no expensive and unreliable interstage audio transformer was necessary.

One characteristic of the pentode assisted its popularity for small cabinets. As we saw last month, a desirable feature of the triode is its low anode resistance which assists in damping speaker cone resonances. Pentodes on the other hand, have a very high anode impedance and in the absence of negative feedback, provide little speaker damping.

The public were becoming aware of the extended frequency range of the moving coil loudspeaker. 'Listen to the bass!' was a popular advertising slogan, but the shift from console cabinets to the limited speaker baffling of small cabinets restricted low frequency performance. However, there was some low fidelity compensation from the pentode's lack of damping, which permitted cone resonances to boom away without inhibition — increasing the apparent bass performance.

Despite its inferior fidelity, the pentode was rapidly accepted and, together with the later beam tetrode, dominated output stage design right to the end of the valve era.

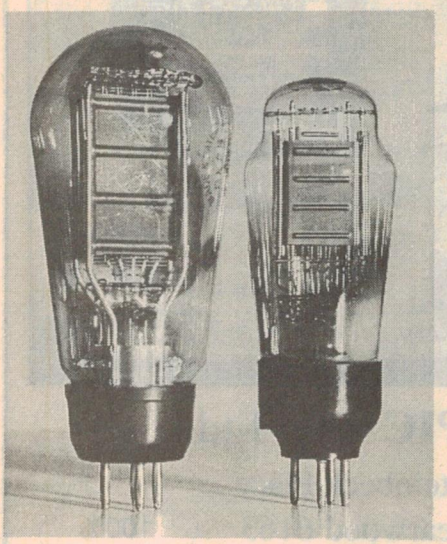


Fig.1: Marconi-Osram's PX4 of 1929 represented a major advance in British power triode development, and was copied by other makers. A typical example is the Cossor 4XP, on the right. At left is the massive PX25, the largest PX4 derivative and a favourite British power triode.

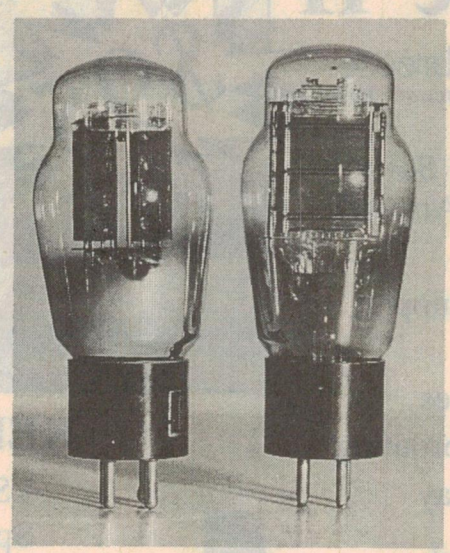


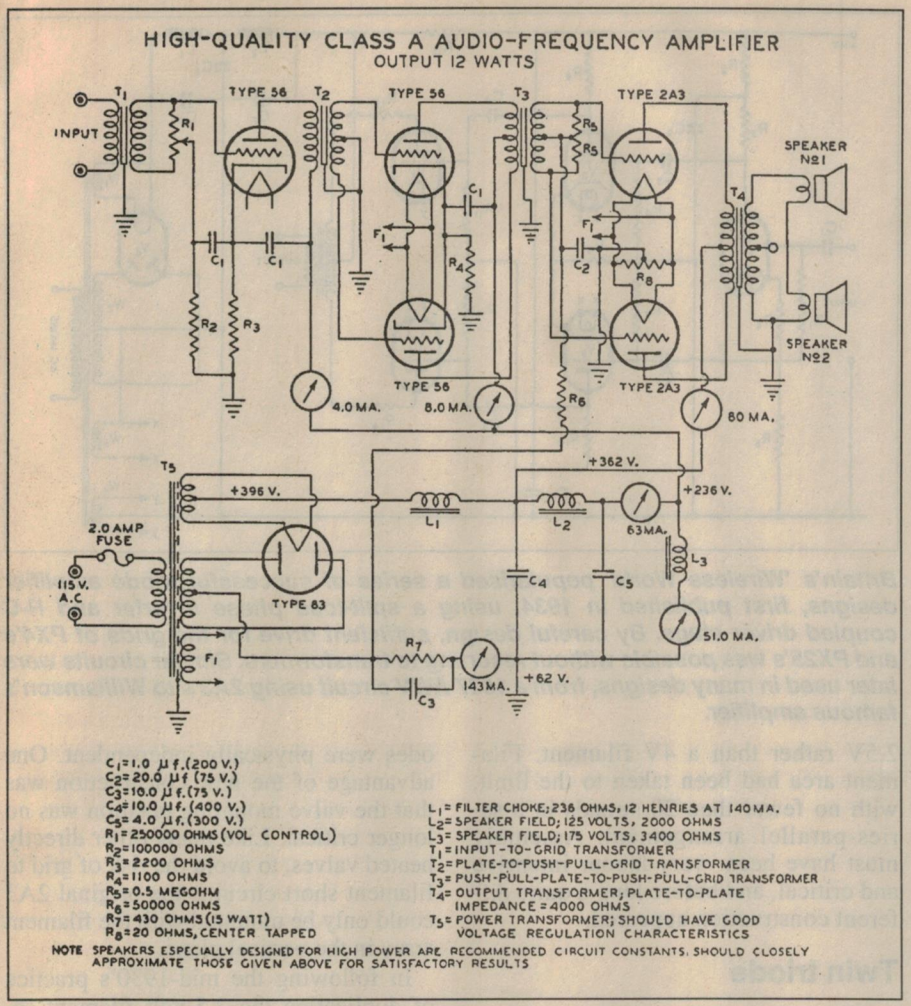
Fig.2: The original American 2A3 on the right had much in common with the PX4, but with a 20-strand filament (the bottom row of hooks is just visible below the anode). On the left is the later and more common pattern, which is effectively two identical triodes connected in parallel.

British breakthrough

But back to 1929. Although an improvement on its predecessors, and quite popular, the recently introduced type 45 nevertheless had some serious limitations. As with most engineering, valve design was a compromise. Amplification factor in triodes had to be traded against anode resistance. A low anode resistance was desirable, but it was achieved at the expense of amplification factor, and therefore sensitivity.

For example, a push-pull pair of 45's with an amplification factor of only 3.5 needed at least 100 volts grid-to-grid drive, for full output. This placed considerable demands on the driver valve, whose distortion could easily exceed that of the output stage. Transformer coupling eased the problem considerably, but good quality examples were very expensive.

The only way to raise the amplification factor of a valve without sacrificing low anode resistance was to increase the mutual conductance. This could be achieved by reducing grid to cathode spacing, which was difficult to do reliably with existing assembly methods, or alternatively by increasing the cathode area.



From the RCA tube manual of 1933, this circuit is typical of American triode amplifier practice in the early 1930's. Transformer coupling simplified the problems of providing sufficient drive for the output stage, but were prone to hum pickup. High quality transformers were also extremely expensive.

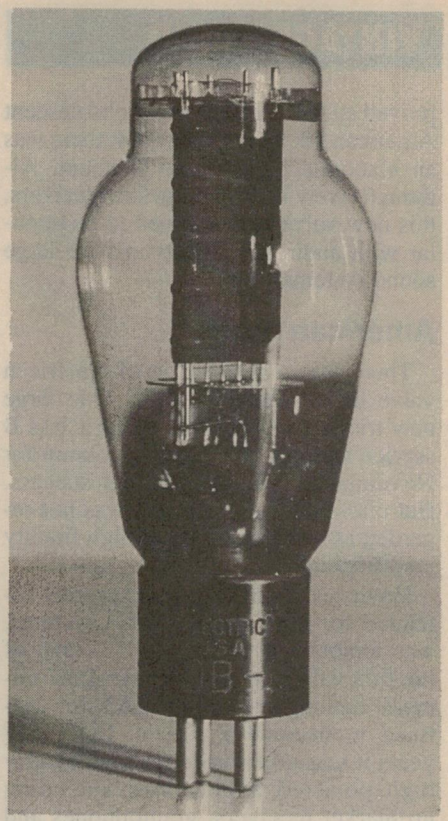


Fig.3: 1933 saw the final development of the traditional power triode. For many enthusiasts the Western Electric 300B, still in production after 60 years, is the finest of its type ever produced.

In October 1929, shortly following RCA's announcement of the 45, Marconi-Osram in Britain released the excellent PX4. This was to become the first of the new generation of output triodes, achieving a mutual conductance figure of no less than 6mA/V — three times that of the 45 — together with a 40% increase in amplification factor and a considerable increase in power output.

Element spacings were reduced, but most significantly, the cathode area was substantially increased. Whereas output valve filaments previously had been 'M' shaped with four strands, the PX4 had eight strands in a double-M formation.

The improvement was impressive. With an anode resistance of only 830 ohms, an amplification factor of 5, and anode dissipation progressively up-rated from 10 watts to 15 watts, a single PX4 was eventually capable of producing nearly twice as much audio power as a 45, but with less drive voltage. In push-pull, a self biassed pair with 350 volts HT supply was rated at 14 watts output. The PX4 was to remain in the catalogs until about 1960, 30 years after its debut.

Other British valve makers soon produced their equivalents of the PX4, and — true to form — used their own identification systems. Cossor barely disguised their version as the 4XP; Mullard made the ACO44; Ferranti produced the LP4, Mazda the PP3/250 and Tungsram had the P12/250. British researchers had been working on new pentodes also and by 1931England led the world in output valve design.

In 1932 Marconi-Osram produced the gigantic PX25, the suffix '25' referring to the anode dissipation of 25 watts. With a mutual conductance of no less than 7.5mA/V and an amplification factor of 9.5, the PX25 was a considerably im-

SINGLE VALVE: TYPICAL CHARACTERISTICS

TYPE	ANODE VOLTS	ANODE mA	ANODE RES	AMP. FACTOR	GRID BIAS	MUTUAL COND	POWER O'PUT
50	450	55	1800	3.8	84	2.1	4.6
PX4	300	50	830	5.0	45	5.0	3.5
PX25	500	50	1265	9.5	50	7.5	8.5
2A3	250	60	800	4.2	45	5.25	3.5
300B	300	62	700	3.8	58	5.4	4.5
KT66	400	62	1450	8.0	38	5.5	5.8

The published characteristics of valves were somewhat idealised. Production tolerances could vary 25% above or below the nominal figure.

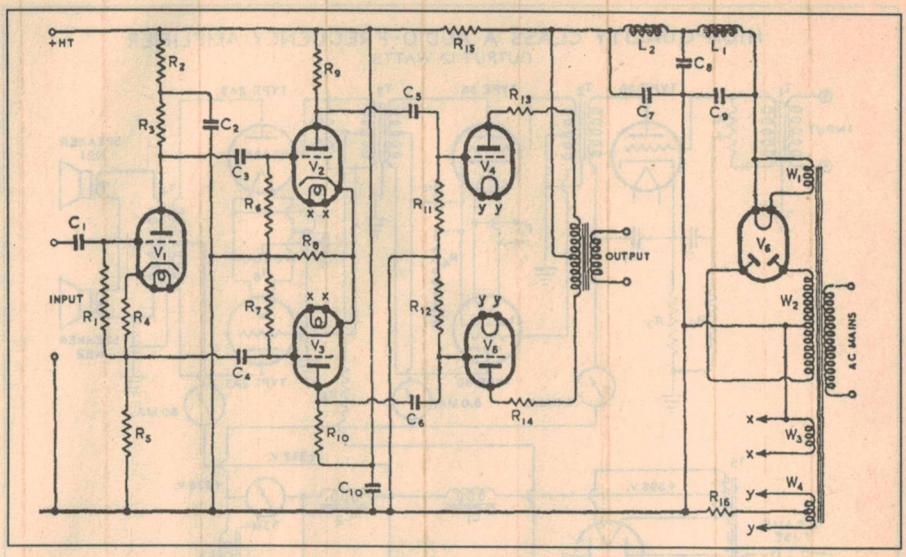
proved successor to the now obsolescent American 50. As with the PX4, there was an elaborate eight-strand filament. Although rarely used in domestic receivers, this new valve was destined to be popular with audio enthusiasts and for large sound systems.

American revival

There was a resurgence of American valve development in 1932. One large new triode, the 46, intended for Class B service and described in this column for November 1991, had limited success. But class B valve operation was not regarded as being suitable for high fidelity amplification.

However, a new triode, expressly intended for high quality audio systems, was announced early in 1933. One of the first valves to use the new alpha-numeric naming system, the 2A3 was destined to become a classic. For many years it was a favourite for high quality high powered applications, including up-market receivers, gramophones and the new electronic organs. Although eventually superseded in many applications by the 6L6 and similar beam tetrodes, as late as 1961 the 2A3 was listed as a current type in the RCA valve manual, and is still available today — but now made in China!

Initially, the 2A3 construction had more than a superficial resemblance to the PX4. It also had significantly similar characteristics, although with a



Britain's 'Wireless World' popularised a series of successful triode amplifier designs, first published in 1934, using a split-load phase inverter and R-C coupled driver stage. By careful design, sufficient drive for the grids of PX4's and PX25's was possible without resorting to transformers. Similar circuits were later used in many designs, from a 1937 AWV circuit using 2A3's to Williamson's famous amplifier.

2.5V rather than a 4V filament. Filament area had been taken to the limit, with no fewer than 20 strands in a series-parallel arrangement. Assembly must have been very labour intensive and critical, and before long a quite different construction appeared.

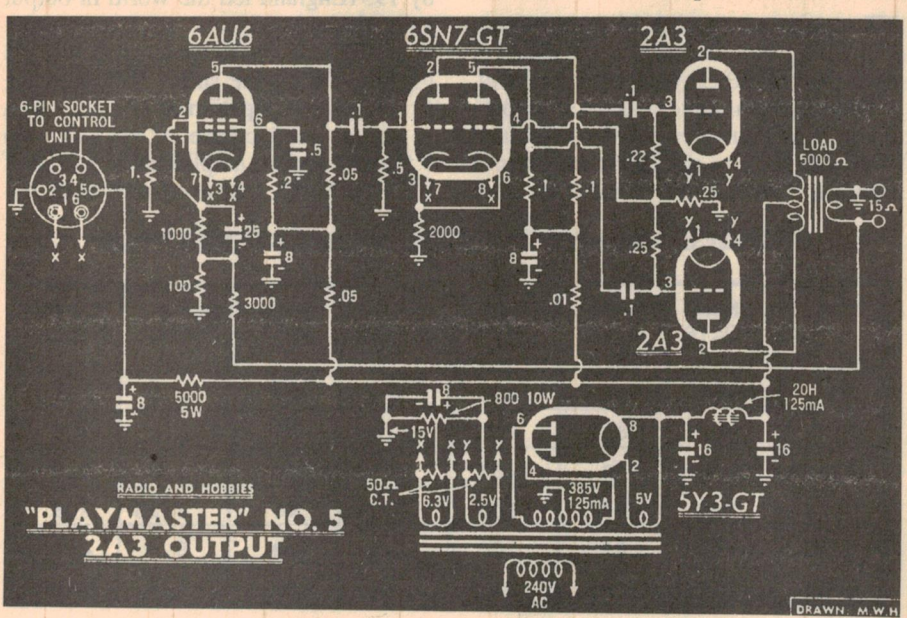
Twin triode

This second type of 2A3 was really two valves in parallel, each with the simpler four-strand M filament. Some makers used a single assembly for the two anodes, but in other patterns the two triodes were physically independent. One advantage of the new construction was that the valve mounting position was no longer critical. Like many other directly heated valves, to avoid the risk of grid to filament short circuits, the original 2A3 could only be mounted with the filament array in the vertical plane.

In following the mid-1930's practice of duplicating the 2.5-volt filament series of valves in the 6.3V range, some American valve manufacturers made the otherwise identical 6A3. Whether or not this duplication was warranted technically is open to question, as individual transformer windings for the directly heated triodes were recommended anyway, and there would have been fewer hum problems with the lower voltage filaments. Later, around 1937, again to keep up with fashion, the 6A3 was given an octal base and titled the 6B4G.

There was yet another modification attempted by at least one manufacturer. All the big triodes had directly heated filaments, as before 1933, indirectly heated cathode technology had not advanced sufficiently to cope with heavy anode current demands. Around 1935, however, there was a strange variation from Raytheon, and possibly other makers. The 2A3H was fitted with cathode sleeves connected, not to a separate terminal pin, but to the centre point of the heater.

Similarly, there was a 6.3V indirectly heated octal equivalent, the 6A5G. Possible reasons were hum reduction, or perhaps to provide delay in current demand at switch-on when used with mercury



John Moyle used 2A3's in the 1952 R&H 'Playmaster' No.5. Although push-pull drivers were best, a few phase inverters such as the paraphase type used here, were capable of meeting the stringent drive requirements of the 2A3 grids.

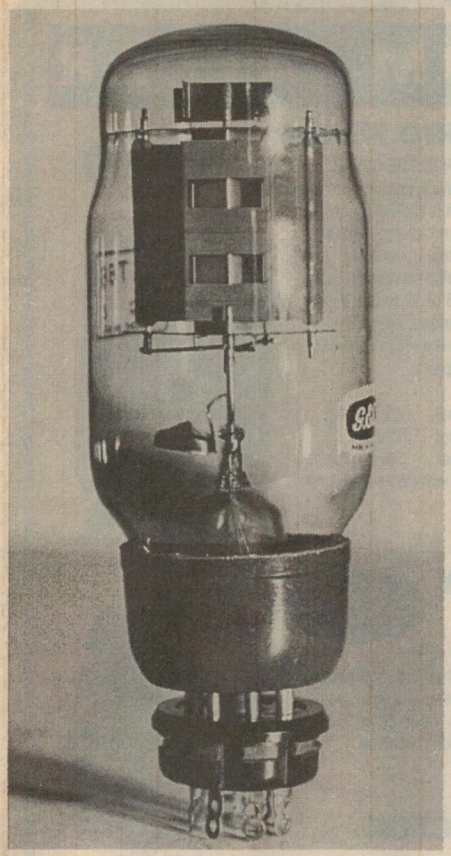


Fig.4: Although a very successful beam tetrode, Marconi-Osram's KT66 achieved considerable international popularity as a triode in amplifiers like the Williamson.

vapour rectifiers. Had the cathode been insulated from the heater, grid biassing might have been simplified, but as it was these valves soon vanished.

Greatest triode of all

The 2A3 family was the last, but very successful, effort by the American RMA in producing big low impedance audio triodes. Later there was to be an unusual output triode that eventually faded into oblivion. The 2B5/6B5 and later equivalent 6N6G had such a high amplification factor that they required a positive grid bias! This caused the grid to draw several milliamperes of continuous current, via a direct coupled small triode in the same envelope — incidently probably the first commercial application of the cathode follower. These odd valves were efficient, but with an anode resistance of 24,000 ohms, behaved generally more like pentodes.

Western Electric had meanwhile b. .n taking stock. Their aging 205 series described last month was, by 1932, inadequate for any but the lowest powered applications, and alternatively, to use transmitting triodes for medium powered installations was clumsy and inefficient. It has been claimed that, to produce no more than 12 watts of audio, the old 43A amplifier consumed 325 watts of power!

Western Electric developed a new triode, the magnificent 300A, commencing production in 1933. To permit its use in amplifiers using the earlier skirted socket, in 1938 there was a modification in the form of a small pin inserted in the side of the base. Otherwise unchanged but renamed the 300B, this remarkable valve has the same amplification factor and power handling capability as the 50 but with greater efficiency, and an even lower anode resistance than the 2A3. With a similar sized anode to the PX25, the 300B also has the eight-strand double M filament and looks very impressive in its large and shapely ST19 bulb.

STC for a while also made their version, the 4300B. These superb valves, largely hand made by craftsmen, were made available for public sale and are regarded by many devotees as the finest audio output triode of all time. A push-pull pair operating with 325V on the anodes can deliver 15 watts for a power consumption of only 50 watts.

Note that I use the present tense. I understand that the 300B is still in production, although under the brand name 'CETRON'. Valve manufacture ceased at Western Electric's Kansas City plant in 1988, 55 years after the introduction of the 300A, and to the 300B went the distinction of being the last type produced there.

If I have tempted perfectionist audiophiles to contemplate modifying their favourite amplifiers to take 300B output valves, be warned. The US list price of a single 300B is $170. According to my calculations, the Australian price for a set of four works out at about $950 without freight! Compare this with a set of Chinese-made 2A3 valves costing about $110.

Honorary triode

There were to be no more big triodes. Any further improvements would have been marginal and multi-grid valves were by now quite suitable for most applications, and could be operated as triodes if required.

The next major development in this story was the 6L6 beam tetrode released by RCA in 1936, and capable of turning out massive amounts of power efficiently. Negative feedback enabled these new valves to provide a fidelity comparable with triodes, but with greater efficiency.

Marconi-Osram the following year created their own series of 'kinkless tetrodes'. The largest was the KT66, equivalent to the 6L6, but with increased voltage and current ratings. As a triode, with the screen grid and anode connected together through a 100-ohm resistor, the KT66 had comparable characteristics to the PX25, but with the advantage of an indirectly heated cathode (by now this was possible for large valves).

This application may have been confined to footnotes on valve data sheets, but for the work a decade later by D.T.N. Williamson. As related in this column for July 1990, he gave details in the April and May 1947 issues of *Wireless World* of an amplifier using a pair of KT66 triodes, which was to set new standards of performance.

Such was the reputation of Williamson's design internationally, that through it the KT66 enjoyed considerable popularity. It is likely that because of this at least as many, if not more, KT66's were used as triodes than as beam tetrodes. So although the KT66 is only an 'honorary triode', it seems a worthy example to conclude this saga. ❖

Collector's Corner

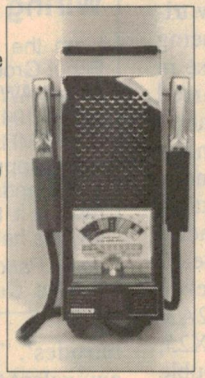
Wiring Diagram Wanted:

I am the Scout Leader at Newmarket Scout Group, and we have just acquired an old AWA Wave Meter Class C, No.1, dated 1942. It tunes from 1470kHz to 10.260MHz, in three ranges. We would really appreciate a copy of the original circuit and/or wiring diagram, so we can restore it to operational condition. Can anyone help?

John Parkin, 49 Barwood Street, Newmarket Queensland 4051.

OCTOBER BARGAINS FROM JAYCAR

BATTERY TESTER



This device will test both 6 and 12 volt conventional car batteries and maintainence free batteries as used in solar power installations etc. To accurately check batteries state of charge the tester draws current while measuring its voltage level. It will check batteries with ratings up to 1,000 CCA (Cold Cranking Amps) and can load batteries up to 100 amps. It will also check the batteries cranking ability, test the vehicles charging system output and test the starter motor. Its simple to use, completely portable, external power is not required and complete tests on a battery can be done in 30 seconds. Its accurate and dependable, with a shock resistant movement, heavy duty colour coded copper plated battery clamps and a heavy duty nickel-chrome plated steel case.
Size: 290(H) x 160(W) x 70(D)mm.

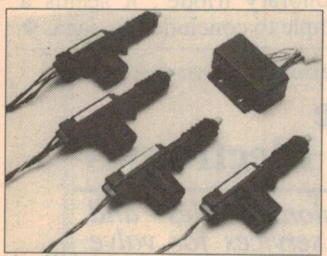
Cat #: QM-1620 **$89.95** NEW

VISION-MATIC GLASSES

Vision-Matic are plastic glasses that incorporate one torch globe on each side for hands free illumination. They are ideal for many situations where the user needs a good torch light and both hands free. Use •for working on the car •camping •night reading •blackouts •night fishing, boating, walking etc etc.
Vision-Matic glasses can be worn over conventional glasses. They require 2 x AA size batteries for each side (4 in all - not supplied). Globes are standard pre-focused torch globes. it also has a belt clip built in for easy carrying.

Cat #: ST-3025 **$14.95** NEW

LOWER PRICES ON CAR DOOR LOCKING SYSTEMS



We have changed suppliers and we are now stocking actuators that are made by the same people who make our quality car alarms. We have also been able to **reduce our prices**.
FOUR DOOR CAR POWER DOOR LOCK KIT
Consists of two master solenoids and two remote solenoids (masters are for the front doors so opening either front door will automatically unlock the other three doors). Also includes a full wiring harness to connect all doors and the power lock relay is also supplied. You can remotely control this system with our Remote Control Switch - Cat # LR-8822 $79.95 which includes two transmitters.

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$199.90 for Remote Door Locking

SEPARATE ACTUATORS
If you own a two door car - you only need buy 2 actuators (2 masters or 1 master and 1 slave) and a power relay.

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Cat #: LR-8832
was $38.95
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save $10.00

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POWER LOCK RELAY
Cat #: LR-8835
$29.95

CD/AUX TO CAR FM SOUND FEEDER

NEW

USE YOUR PORTABLE COMPACT DISC OR WALKMAN IN THE CAR!!!
Sound Feeder is a convenient way to play your CD or Walkman on your cars stereo system. Sound Feeder converts the signal to FM which is picked up on your FM stereo receiver. Simply plug Sound Feeder into your cigarette lighter, connect the audio input wire to your portable player, tune in your FM receiver and you have STEREO sound. Sound Feeder also contains a DC to DC voltage convertor to drop the vehicles 12v to 4.5, 6 or 9v to power the portable player. Sound Feeder combination of stereo sound, easy installation, portability and power supply feature make it an ideal accessory for all cars. Supplied with four different DC power adaptors.

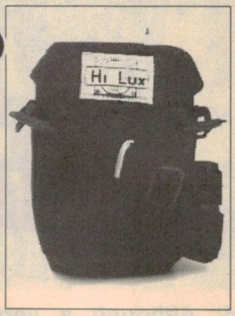
SPECIFICATIONS:

Operating voltage:	12-18VDC	Max input signal:	400mvpp
Consumption current: (no input signal)	22mA	Audio input imp:	1 ohm
		Audio response:	50Hz - 15kHz
Tuning frequency:	88-108mHz	Size:	90(L) x 51(W) x 21(H)mm
Channel separation:	40dB		

Cat #: AR-1750 **$47.95**

RECHARGEABLE BATTERY CARRY CASE

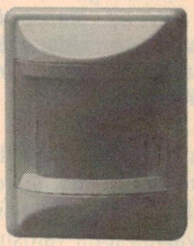
NEW



This case will accept a 6.5Ah gel battery. It is ideal for video camera users or for hand held 12 volt spotlights for shooters, night bush walks etc. It has leads for connecting to the battery inside the case (positive lead is fuse protected) and a cigarette lighter socket is mounted on the side. It has removable strap for hanging on the shoulder and a belt loop.

Cat #: HB-5950 **$24.95**

BELLMATE 200 PIR DETECTOR AVAILABLE IN OCTOBER



The baby of the Bellmate PIR range. The 200 breaks another price barrier. It is the first time we have been able to offer a quality PIR with 12 months warranty for under $35. Amazing!!!
FEATURES AND SPECIFICATIONS

- Dual element pyroelectric sensor
- 24 dual element zones in 3 layers
- Wide angle 90° multi layer coverage
- 12 metre range
- Operation voltage 9 - 16V DC
- Current draw 20mA
- Tamper proof

- LED indication
- Relay output. N.C.22Ω for shorting protection
- Max rating 0.5A 24V DC resistive
- Colour white
- Size 93 x 73 x 43mm
- Hall lens Cat. LA-5014 $4.95

Cat. LA-5017 **$34.95**

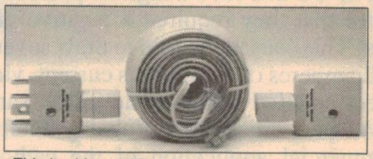
GUITAR SPEAKER MADNESS

12" 200WRMS Cat #: CG-2381
was $159 now $125 save $34
15" 150WRMS Cat #: CG-2382
was $129 now $99 save $30

THE LATEST KITS FROM JAYCAR

PC Controlled Eprom Programmer	KA-1752	$99.50
Decoder For ACS Signals	KA-1753	$18.95
Noise And Distortion Meter	KA-1751	$139.50
1GHz Frequency Counter	KA-1750	$149.50
50mHz Frequency Counter	KA-1749	$89.50
DSO Adaptor For PC's	KA-1748	$85.00
5v to 12v Convertor	KC-5137	$24.95
In Circuit Transistor Checker	KC-5136	$14.95
Colour Video Fader	KC-5135	$29.95
Digital Voltmeter	KC-5134	$32.95
Woofer Stopper	KC-5133	$49.50
Nicad Cell Discharger	KC-5132	$27.95
LED Audio Power Meter	KC-5131	$24.95
Alarm Triggered Camera	KC-5130	$49.95
Camcorder Mixer	KC-5129	$29.95
Low Fuel Indicator	KC-5128	$11.95

PHONE EXTENSION LEAD BARGAIN



This lead has a 15 metre length of telephone cable with a U.S. 4 pin plug on each end. Also supplied are two adaptors. One accepts the U.S. plug and converts it to an Australian plug. The other adaptor is from the U.S. plug to and Australian socket. So you can have any combination of U.S. plug to Aust plug, U.S. plug to U.S. plug or U.S. plug to Aust socket all 15 metres long. Adaptors cost $6.50 each and the lead is about $8. That's over $20 value.

Cat #: YT-6050

NEW **A BARGAIN AT $9.95**

JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS

AMPLIFIED WALKMAN SPEAKERS

We now stock two pairs of Walkman speakers, both with built in amplifiers. They will make your Walkman cassette or portable CD sound great, and enable everyone to hear what's playing. We evaluated quite a number of these speakers before deciding on these two, which offer excellent sound quality and value for money.

NEW

STEREO SPEAKER SYSTEM WITH DXBB

These speakers have a built in amplifier which delivers a genuine 3 watts to each speaker. They incorporate the following features: •DXBB - Dynamic Extra Bass Band control system which extends the high and low frequency response without overloading the amplifier. A LED shows you when DXBB is working. •Double Bass and Treble switches. When switched on the Bass and Treble is double normal operation. •Power Switch / Direct In. The amplifier can be turned off and the unit acts as an ordinary stereo speaker system. Power handling is 3 genuine watts. •Speakers can be locked together for easier handling. •Use 4 x C batteries or 6VDC mains adaptor (not supplied - use model MP-3010 $19.95). •Gold 3.5mm stereo plug supplied. •Size: 155(H) x 110(W) x 60(D)mm.

NEW

Cat #: AS-2960 **$39.95/pair**

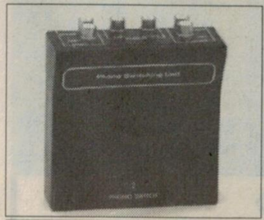
HIGH POWER STEREO SPEAKER SYSTEM

NEW

These are the big brothers to the AS2960. Their built in amplifier delivers a genuine 4 watts to each speaker. Features include Double Bass and Treble switches, power LED indicator, large cabinets for better sound. The amplifier can be switched off and the unit acts as an ordinary speaker system. Gold 3.5mm stereo plug supplied. Use 6 x C size batteries or 500mA plug pack Cat MP3012 $22.50.
Speaker size: 150(H) x 80(D) x 90(W)mm.

Cat #: AS-2962 **$49.95/pair**

BUDGET AUDIO SWITCH



NEW

If your amplifier has not got enough inputs, this switch will help. It has two sets of RCA sockets for inputs and one set for output to the amplifier. This will allow two components (eg CD and Laser Disc) to be connected to the one amplifier input. Supplied in a plastic box with rocker switch for selecting input. Size: 90(W) x 100(D) x 35(H)mm.

Cat #: AC-1656 **only $17.95**

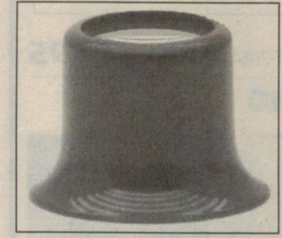
TV ANTENNA AMPLIFIER

This handy device is designed for indoor use and simply plugs into a power point. The antenna lead is plugged through the amplifier. Its ideal for low reception areas or installations where several TV's are being used from a single antenna. The gain is adjustable from 0-20dB and the attenuation is -12dB. Max output is 98dBuV and the boost frequency is 40-900mHz. This covers UHF, VHF and FM signals. Noise figure is 5dB & the input / output is a coax TV socket.

NEW

Cat # LT-3282 **$49.95**

EYE MAGNIFIER



This 3 times magnifier simply sits on whatever you are magnifying. It's perfect for checking PC boards, looking at stamps or coins, jewellery etc etc. Every hobbyist should have one.
Size: 28(h) x 22(dia view area) x 40 (dia base)mm.

Cat. QM-3515 **$4.95** NEW

SEALED ABS ENCLOSURES

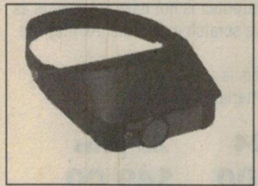
Jaycar are proud to announce a brand new range of top quality sealed ABS enclosures to add to our sealed die cast range. Jaycar are exclusive agents for these boxes, and our wholesale department can offer excellent discounts for quantities.

FEATURES INCLUDE:

- High impact ABS material moulded in dark grey colour. They are easily drilled or punched making them ideal for use in the electrical and electronic industries as circuit board enclosures or simply as junction boxes.
- Lids and bases incorporate a tongue/groove sealing system with a neoprene gasket.
- Wall mounting holes & lid fixing screws outside the sealing help to prevent moisture and dust entering the box.
- Bosses on internal base allow horizontal fixing of PCB or for connection of terminals etc into threaded brass inserts
- Designed to IP65, IEC529 and NEMA4 (dust and hoseproof)
- Vertical internal guide slots for mounting PCB assemblies
- Lid fixing screws are M-4 into threaded brass inserts
- Operating temp: -20° to +80°C.

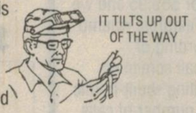
	External Dimensions(mm)				Price
Cat No:	L	W	H	Wall Thickness	1-9
HB6120	64	58	35	3.0	$3.95
HB6122	115	65	40	3.0	$5.50
HB6124	115	65	55	3.0	$6.95
HB6126	115	90	55	3.0	$8.95
HB6128	171	121	55	3.0	$13.95
HB6130	222	146	55	3.0	$16.95

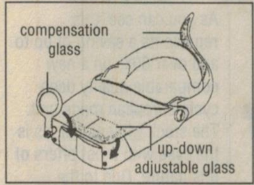
HEAD MAGNIFYING GLASS



NEW

These headset glasses allow unrestricted user efficiency while reducing eyestrain. They leave both hands free, offer a wide field of vision and can be worn over prescription or safety eyeglasses. When not in use, they can be tilted up out of the way. There are 4 different magnifying multiples: X1.8, X2.3, X3.7 and X4.8. Looking through the single lens is X1.8. Swing the round magnifier down and it becomes X3.7. Clip the second large lens down (that folds up inside the headset) and you get X2.3. Again swing the round magnifier down and you have X4.8 magnification.
The headstrap is adjustable, with a velcro tab for holding in place. These glasses have many uses from checking circuit boards to reading resistors plus all the other industries that require close magnification.





Cat. QM-3510 **$39.95**

AA NICAD BATTERIES

700mAh with solder tags - Cat. #: SB2451.
$3.75 each

500mAh rechargable - Cat. #: SB-2452
4 for $10.00

NEW

500mAh with solder tags - Cat. #: SB-2453
$2.95 each

700mAh rechargable - Cat. #: SB-2450
$3.50 each or 4 for $12.50

JAYCAR WHOLESALE

OEM's, MANUFACTURERS, RESELLERS, SERVICE AGENTS, INSTALLERS ETC, ETC.,
CONTACT OUR WHOLESALE DEPT. FOR BULK PRICES
PHONE (02) 743 5222 OR
FAX (02) 743 2066

JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS

BARGAIN PRICED TELEPHONE PRODUCTS

Jaycar has purchased a quantity of telephone products from ATD. These have been returned to ATD from large retailers who have declared them faulty. These are checked and many are found to be OK, the faulty ones are fixed. They can't be sold as new because they may have a mark on them and probably have no box. All units are supplied with instructions and accessories. All goods have a 30 day replacement guarantee. The Cat #: YT-7082 has an additional subsidised warranty for another five months. This is $25 repair charge plus freight. The goods offer fantastic value for money.

TELEPHONE CLOCK RADIO

The price is so low, we must be mad!! Buy 2, one as a spare! Features: Clock Radio • one touch control buttons • large radio on/off selector • wall or desk mountable • large LED clock with display • PM/alarm indicators • rotatable clock display • LED radio tuning indicator • battery backup • wake to alarm or radio • automatic radio muting for incoming calls • radio music on hold • snooze facility Telephone • ringer on/off • ringer indicator • mute & last number dialled functions • 30 day exchange warranty. No fixee after that. Reworked stock. - STILL SELLS FOR $65

Cat. YT-7084 **only $19.95**

TELEPHONE CLOCK/RADIO

The ATD Model 3550 is packed with features which include: •Telephone • 10 memories • Last number redial • Save memory • Tone/pulse switchable • Ringer volume on/off control • Recall key (for PABX) • Wall or desk mount Clock Radio • AM/FM radio • Large green display • Brightness control for display • Automatic radio muting when using phone • Battery back-up for time and alarm • Wake up to alarm or music • Snooze function for alarm • Sleep function. Re-worked stock. 30 day exchange warranty. No fixee after that.

Cat. YT-7086 **only $32.95**

Bargain Priced ATD Answering Machine

The ATD 1800 is a very popular answering machine. All the big stores and discounters sell it for $99. These are in our catalogue for $59.95 and we have sold hundreds. Features: •memo recording •digital recording of outgoing messages •call screening •voice activated recording •built-in mic •message indicator & number of calls. We've been able to further reduce our price of this machine. All units are supplied with instruction manuals, phone lead and power plugpack. Three month replacement warranty applies to this product. Probably Australias best selling machine. Re-worked stock.

Cat. YT-7028 **only $49.95**

COMBINED PHONE & REMOTE ANSWERING MACHINE

The Phonewatch 1830 gives you the benefit of the following features:- Telephone: • Last number redial •Tone/pulse switching • Ringer on/off • Wall mountable. Answering machine features: • Digital recording of outgoing messages • Remote turn on/off • Toll saver feature • Memo recording • Call screening • Voice activated recording • One touch playback • Built-in microphone • Two-way record • Remote access to play incoming messages • Message indicator • House monitoring • Call breakthrough - priority breakthrough. Supplied with mains plugpack, telephone lead, tape and instructions. Re-worked stock. 30 day exchange warranty. For next 5 months special repair price $25.

Cat. YT-7082 **only $89.95**

Stereo Audio Mixer With Equaliser, Auto Talkover & Sound Effects 8 Inputs/3 Outputs

19" Rack Mount - Ideal for professional DJ's etc Features include • two microphone inputs • six stereo inputs • level control for each stereo input - switchable • LED bargraph VU meters • rack mount • talkover • fader • bass and treble control (Equaliser) • master output volume control • headphone monitor volume control • cue monitor • sound effects - bombing, laser, ambulance, shooting, siren, machine gun, telephone, storm • 240V operated • Dimensions 482(L) x 200(W) x 75(H)mm. Standard 19" rack mounting.Specifications • same as AM-4202 (see our 1993 cat).

Cat. AM-4208 **was $249 October only $199 save $50**

6V - 140A/HOUR DEEP CYCLE BATTERY

ATTENTION !!! SOLAR POWERED HOMESTEAD OPERATORS!
An interesting story.....
Jaycar has made yet another massive scoop purchase! This time it is a French made 6.0 volt - 140A/Hr Deep Cycle Lead Acid Battery. If you operate from Solar Energy you will realise that Car Batteries are really not suitable for stand-by DC power banks. What is required is a very well made low internal-leakage current battery that will hold a charge indefinitely.
Unfortunately such batteries are extremely expensive - BUT NOT NOW!!!
Recently the half million dollar battery bank of a large Australian company was replaced because a fire extinguisher alarm tripped, covering many batteries in fire fighting foam. The ensuing insurance settlement saw perfectly good batteries replaced. The batteries were removed from the location and hosed down (they are completely sealed). These batteries still work to manufacturers specifications and are about two years old. They have a design life of over ten years (to spec) - That's why they cost a lot in the first place!!
These batteries cost over $300 each new in 500 lots, but they are not, we repeat not, new. Jaycar purchased all of the salvageable batteries (some were broken when removed by clumsy people). Our buy represents a massive price saving for a potential user of such batteries. Whilst we emphasise that the product is not new, it presents as new and works as if brand new. Some cases may have scratch marks etc. As they are completely sealed, this is of no consequence.
If you wish to make a large deep cycle battery bank this is a once-in-a-lifetime opportunity. Shown below are the prices for these batteries in quantity.
Cat. SB-2476

1-4	5-12	13-24	25 plus
$89.00	**$69.00**	**$59.00**	**$49.00**

As you can see, this represents a saving of up to and over 80% on a new comparable quality deep cycle European made unit. The stock will not last, as is the case with most offers of this nature. Due to the massive weight of each battery (they weigh 25kgs each!!) there is no mail order service unfortunately. You will have to bring a truck around to collect them. We are so excited about the quality of these batteries we have given them a six month warranty, even though we bought them as is. This is subject to our normal terms and conditions. Full specifications are supplied with each battery.

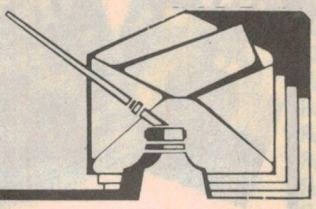
NEW

SPECIFICATIONS

Rate	End Voltage Vpc	Capacity Ah
20 hour	1.75	132.0
10 hour	1.80	116.0
5 hour	1.70	114.0
3 hour	1.65	103.8
1 hour	1.60	82.5
30min	1.60	72.0
15 min	1.60	61.0

- •Nominal voltage: 6 volts
- •Max current during a 10sec discharge 800A
- •End voltage 4.70v
- •Minimum short circuit current 2700A
- •Internal resistance (battery fully charged) 1.5mΩ
- •Dimensions - 355(l) x 170(w) x 185(h)mm

Information centre



Conducted by Peter Phillips

Lamps, RFI, falling trees and more!

Different types of lamps get into the column this month, including an interesting question about the connection of a fluorescent light ballast. There's the usual range of comments, questions and answers — and a follow-up to the effect of a voltage surge on the mains.

It's almost five years now since I took on the role of conducting Information Centre. Judging from the mail we receive, it seems this column is a popular part of the magazine, as it lets virtually anyone have a say, ask a question or even have a whinge.

By far the greatest number of letters are about the What?? question I present each month. Over the last five years I've presented some 60 electronic/-electrical teasers, and some of these have obviously caught your imagination. You might remember the time I had to devote the entire column to an explanation of the answer to a question, such was the controversy.

Last year I promised I'd put your name in the column if you could figure out the resistance of a particular resistive network. What I didn't count on was that this would bring 150 or so replies! We even had a red herring once, when a reader suggested the information given with the question itself was wrong. The problem was I agreed with him, and got myself into all kinds of bother.

Some readers might also remember one of the first questions I ever presented where, after extolling the virtues of the question, I didn't notice the typo in the answer. So looking back, it's been fun — and I trust very informative. But unfortunately I've now run out of suitable questions.

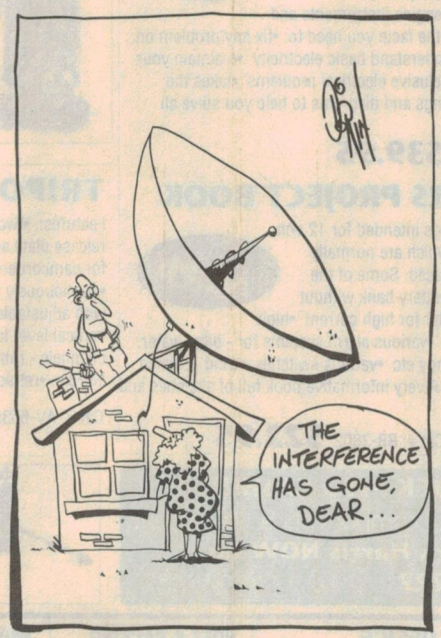
This month you'll notice I'm asking a Why?? rather than a What?? question, as I want to keep this part of the column going. But I need those questions, folks. So over to you!

And now to this month's letters...

QI dimming

I included a letter in the July issue from a reader wanting to know if he could dim his quartz iodine lighting installation. I may have overstated a problem with doing this, as the following letter points out...

Regarding dimmers for QI lights, we have had three QI's on dimmers in the lounge room for around three years. They are used every night and at different intensity, with no trouble other than the dreadful radio interference and the smell of burning moths that fall in. The bulbs are still original.



Maybe they shouldn't work, but these seem to! (R.D., Ourimbah NSW).

After getting this letter I referred back to the colleague who had advised me in the first place, about the problems of shortened life when a QI light is operated below its normal operating temperature. While it's true the lamp life is reduced, it's not quite so drastic as my comments in July might have conveyed. The life of a QI light is around 2000 hours (so I'm advised), which is halved if the lamp is not operated at the correct temperature. This still equates to a long operating time, probably explaining why R.D. has so far not had to replace a QI light.

Dimmers for a QI light installation are different to a conventional lamp dimmer, because of the transformer load. Regular readers of this column will know by now that gate current to the triac must flow during the entire ON time of the triac, compared to a trigger pulse as in a normal dimmer.

However, there are also special QI light dimmers that have a 'restore' cycle, where the QI lights are operated at full temperature for a brief period. During this time the material burnt off the filament is recombined. In some dimmers this cycle occurs at switch off.

So we are both right, J.D. Because you're probably operating the lights at full power some of the time, the filaments are being restored to some extent, giving a longer life than if you operated the lamps at half brightness *all* the time.

The problem of RFI is quite common, so perhaps the next letter might offer a solution.

AM interference

I note your response in July to C.H. of Warners Bay NSW, who is experiencing RF interference from lamps, and your comments re RFI from dimmers and computers. As you say, removing the antenna to a 'cleaner' location is the answer.

In my case, the computer that produces the RFI is right next to the radio, and the answer boils down to using an external 'aerial' and a dedicated earth stake. These are brought to the receiver using a coaxial cable.

A little coil (about six turns) is wound onto the loopstick antenna which usually comes with tuners these days. This coil is fed from the coaxial cable. The orientation of the loopstick is then varied to get a null in the noise. Depending on the loopstick mounting, it may be necessary to reverse the coax connections to correctly phase the signals from the outside antenna and the inside loopstick. (In my case I can rotate the loopstick a full circle, so this isn't needed.)

The theory behind this approach is that there are two signals: wanted signal plus 'major' RFI signal, and wanted signal plus 'minor' RFI signal. By combining the two signals in opposite phase in the right ratio, a part of the 'major' RFI cancels the 'minor' RFI without too much of the wanted signal being neutralised. The phasing and ratio are selected by the sense of the little coil and the rotation of the loopstick. (R.V., St Georges Basin NSW)

As ever, R.V., thanks for this simple yet effective approach to a vexing problem with AM reception. While R.V. has the floor, here's what he has to say in defence of his previous suggestion about using an electrolytic capacitor in a car.

Criminal?

You might remember a letter in June (from K.W., Hawthorn Vic) protesting strongly against fitting an electrolytic capacitor inside the interior lamp of a car. The idea was contributed by R.V. as a way of improving the response of a car alarm which senses the voltage drop caused by the interior light being turned on when a car door is opened. Here's R.V.'s reply to K.W.:

I read with some surprise in June's edition the remarks by K.W. about using electrolytic capacitors in cars. I've never seen the result of an exploding electrolytic, as I'm not a professional in the field. However I think the application of a few extra volts above an electrolytic's rating would not be a problem as they are not manufactured with such a tight tolerance.

As well, there are all sorts of ways to minimise the likelihood of an explosion — such as making sure the capacitor is placed well away from the (3W) lamp, connecting two capacitors in series and so on. Perhaps you could first test the capacitor by subjecting it to 24V DC (which is far higher than you'd get in a car). If you like, put a bucket over the capacitor during the test.

But there are very few human activities devoid of risk. To regard using an electrolytic inside a car as almost criminal and worse than dynamite is stretching things a bit far! Let's list a few somewhat more 'criminal' activities. Having a shower, driving a car that's not fitted with an airbag, not regularly X-raying the stub-axles of a vehicle, playing sport, going to work with a cold.

The object of readers contributing to your column is in a small way like presenting a scientific paper to one's peers — exposing notions to others who have like interests, hoping to stimulate discussion and constructive criticism. I guess K.W. intends just that and he has gone in hard to drive home his point on the dangers of electro's, of which he has had personal experience.

For troubling to share this experience with those of us who lack it, we should thank him. (R.V., St Georges Basin NSW).

Yes indeed! I like to think this column is a mini forum for ideas, criticisms and comments. And if the comments get a bit emotive at times, then all the better. The next topic was also started by R.V...

Boat speedo

In January, R.V. suggested we (or someone) consider designing a speedo for boats based on a magneto-hydrodynamic principle, where a moving current-carrying conductor (water) induces a voltage in a sense coil. He also suggested we add a few enhancements such as an audible tone related to speed. Since then I've received details of a commercial unit (described in July), and the following letter — which kind of puts a damper on the whole idea...

In the July issue, C.D. responded to half of the problem posed by R.V. in the January issue, giving one example of the commercial use of magneto-hydrodynamics in a ship's log. The other half of R.V.'s problem related to the use of a variable pitch to indicate to the skipper or crew whether or not a particular adjustment made his craft go faster or slower.

About 15 years ago I suggested this concept to my two competitive sailing (sibling) skippers. Despite their discouraging remarks, I pushed on with the design, and eventually came up with a working model. It had the lot: no bigger than a matchbox, made from casting epoxy, completely waterproof and so on. And it worked, transmitting its all-demanding insistent signal to one or more transistor radios operated by the crew of three on each of the two senior class racing dinghies.

I must say that they were all very polite about it afterwards, but assured me that they could do rather better without it. Which sort of brought me back to where I started 15 years ago. Sorry R.V. (R.H., Mt Pleasant WA).

It's the old story, an idea is only as good as others think it is. Still, R.H., I'm betting there's a few boatie types out there reading this and thinking they would like one of these. I've only had limited experience in boats (my son's Manly Junior), but I would have thought a device like this would be popular among the sailing fraternity.

So perhaps your detractors are not representative of all sailors. I'll be interested in the response readers have to your 'invention', as the topic has generated quite a bit of interest.

Our next letter is also about another application of the magneto-hydrodynamic principle...

Water velocity

The contributor of the following letter has included a total of 37 pages of handwritten, very detailed information on the design of an electromagnetic device to measure the velocity of water.

I notice in the July Information Centre that the electromagnetic log has been mentioned for the second time. While I don't think this is a feasible do-it-yourself project, you might be interested in some information on the closely related electromagnetic current meter.

To a hydrologist, a 'current meter' is a device for measuring water velocity. The hydrologist maps out a given river cross-section, then maps out the velocity distribution in that cross-section using a current meter. By mathematical integration, the volume flow rate in cubic

metres per second can be found. The usual way is with a calibrated 'fan' that operates a sealed reed switch once per revolution. The switch then operates a timer/counter.

The attached information is from memory, but it might be useful if you decide to develop either a boat speedo or water velocity meter based on the electromagnetic principle. (R.H., Killara NSW)

Thanks for the information you sent, R.H. Looking through it I notice that the design of the sensor probes (and their position on a boat hull) is as important as the electronics. I also notice that commercial probes are in the order of a $1000 or more.

The electronics of the device is also quite complex, and is a mix of linear and digital technology. In fact the more I look at the whole thing the more I realise it's not magazine project material. Commercial instruments cost $10,000 or more, and from your material R.H., I can see why. Unfortunately readers will have to take my word that the design is complex, as we don't have space to include the details.

And now into the world of make-believe...

Ring simulator

I'm sure someone has the answer to this simple problem. If I had time I'd knock up a circuit myself, but it must have been done before, surely...

I am writing to ask about an electronic device that simulates the ring-space-ring-space-space-ring etc., format of the ring of a telephone. I realise this system is not a part of the phone, so I can't salvage or copy the circuit.

I want a device that could run a relay or switching transistor, to use in a repertory theatre for simulating the real thing.

If you have published a circuit that would do the job, or know of anyone who can help, I'd be most grateful. (John Bishop, RSM 186 Busselton WA 6280).

I'm not sure how it's done in modern exchanges, but I know the telephone ring sequence used to be done with a set of contacts operated by a motor driven cam. To achieve the same thing electronically shouldn't be difficult, and would probably include a couple of 555 timers. If anyone can help John, I'm sure you'll at least get free tickets to the production.

(Editor's Note: We published the design for a Telephone Ring Simulator in the June 1992 issue, described by Colin Mitchell. However it used surface-mount technology and a 'mini piezo' speaker, so it may not be suitable for Mr Bishop's needs...)

Megger

It seems the insulation resistance tester presented in July has met with some approval, including from our next writer — who has more than the usual right to comment:

My commendation on your excellent insulation resistance tester in the July issue. About 12 years ago, EA published a design of mine. Yours is better, though I was going for the ultimate el cheapo design.

As a long-term member of ELI — the faceless Standards committee that

produces AS 3000 — might I say your device hits the spot, having correctly interpreted the rules.

However, I wonder about the comment on page 72 about getting a nasty shock from the instrument. This would only apply to discharging the 0.33uF multiplier capacitor. The instrument user could not suffer more than 5mA from the instrument terminals.

If you consult AS 3859, the Effect of Current on the Human Body, you'll see this current is relatively safe and not especially painful. (Brian Byrne, Indooroopilly Qld).

Thanks for the nice comments, Brian. It has been a popular project, and I've had other letters commenting on the project's relevance to the AS 3000 wiring rules.

Concerning the safety warning, you're quite right about the 5mA shock current. While I haven't tried it myself (I have a real problem with any kind of electric shock), the output voltage of the device falls to about 50V across a 10k load. This resistance equates to that of a human body, and the current by Ohm's law is therefore 50V/10k or 5mA.

However, we would be remiss not to remind readers that the output is capable of giving an electric shock, even though it might be neither fatal nor even particularly painful. After all, there's still a danger, though fortunately not a great one. Perhaps that's another plus for the project!

And here's another letter on the same project...

Would it be possible to obtain the transformer details and the FSD current of the VU meter used in the insulation resistance tester project described in July 1993. Also, is the PCB available as a separate item?

While I have pen to paper, I would like to point out that MEN stands for Multiple Earth Neutral, although the main earth of each installation is in fact earthed. The 'multiple' refers to the earthing of the neutral conductor at every fourth pole from the the distribution transformer. (F.H. Mundingburra Qld).

Thanks for this information, F.H. You're quite right and I guess I got my M's mixed up as I called it Main Earthed Neutral in the article. My confusion stems from the fact that the neutral of each installation is connected (at the fuse box) to the main earth of the installation. I wasn't aware the neutral was also earthed as you describe. It's been some time since I studied electrical wiring!

Concerning the details you seek, this project was designed by Oatley Electronics and I have no idea of the transformer details.

Also, because I no longer have the prototype, I can't even measure the FSD current of the meters. However, I know Oatley Electronics are very obliging with these sorts of requests, and I suggest you contact them directly. As far as I know, they will also sell the PCB for their kits separately.

Capacitor codes

Capacitor value codes are one of the least understood codes of all. The next letter asks for help — although by the writer's own admission, it seems there may not be a single standard that always applies.

Can you help me decipher the meaning of the marking 103K2J on a Greencap capacitor. I have a few reference books on capacitor codes, but I can't

find the exact example. The shops have given conflicting answers as to what the 2 and the J stand for. The voltage rating might be tied up with these characters, as it is not otherwise shown.

I am restoring an old valve amplifier that has a number of silvered mica capacitors with values as low as 270pF. As these are hard to find, what can I use in their place? Obviously polyester and ceramic capacitors are not suitable as they weren't used in the original circuit. (J.S., East Burwood Vic).

Like your research J.S., mine doesn't really come up with a definitive answer either. According to the references I could find, the K means a tolerance of 10%, the 2 is the percentage temperature range and the J refers to the worst possible percentage change in value of the allowable temperature range. Unfortunately, I can't give any values here, as none of the references I checked included the number 2 or the letter J.

However, I doubt if it indicates working voltage, and for a polyester capacitor you are probable safe assuming 100V or so. Of course, the capacitance value is 10000pF or 10nF (or 0.01uF).

(Editor's Note: Sorry to interrupt again, Peter, but page 200 of the current Dick Smith Electronics catalog gives quite a good rundown on capacitor coding. It lists the 'J' as standing for a temperature coefficient of +/- 120ppm/°C...)

Regarding replacement capacitors for a valve amplifier, if you can't get silvered mica types, I suggest you use low K ceramic types or even polycarbonate capacitors.

These are available in the value range you need, and have the same stability. A possible problem is the working voltage, as you'll probably need at least 400V rated types, which might be hard to find.

You might contact Farnell Electronic Components (72 Ferndell Street, Chester Hill, NSW 2162 or phone 02 645 8888) as they have silvered mica capacitors in a few values. They might also have suitable replacement types.

Voltage surge

Last month I included a letter from a contributor describing a first-hand experience with the effects of a mains voltage surge and the effectiveness of a surge protector. There's a bit more to the story, which I'm sure will interest you...

Since my last letter I have been unable to repair the modem damaged by an over-voltage surge. It seems damage has occurred to some of the customised ICs and a replacement PCB is $110. The owner has since referred the matter to his insurance company, who will cover him providing he obtains acknowledgment of a supply surge from the power supply authority.

The authority has since confirmed they will do this without admitting fault or liability. It seems the cause was the 'falling of a tree which hit the 22kV lines and caused a bridge to occur to the low voltage (240/415V) lines'. Some suspicion apparently remains on how the tree fell, as it had been partially sawn through in a way to promote it falling over the lines.

I thought readers would like to know just how some types of voltage surges occur, along with the reassuring knowledge that surge protectors really work. (B.H., Heathmont Vic).

Most interesting, B.H. From your previous letter I assumed (as you probably

did) that the storm you mentioned was the cause. Instead it would appear some people get their kicks dropping trees over power lines!

VCR backup system

I included a letter in April from a reader suggesting using a VCR as a means of backing up a computer hard disk. I had reservations about the time required and the complexity of the software, but admitted it should work.

I've since received brief details of a software package for the Amiga computer that lets you back up its hard disk on a VCR.

The package is called Video Backup System (VBS), and it claims a backup speed of 800K bytes per minute. I previously commented on the time it would take to backup a hard drive, and from this figure it would take 100 minutes to backup an 80MB drive. Slow, but not impossible.

Unfortunately the information doesn't tell me cost, availability for other systems, where you buy the software or how it stores the data. Still, it's interesting to know that the idea is now a commercial reality. It has a claimed reliability of 'three medium sized file failures during backup from a 240MB drive'.

Why??

As I mentioned in my introduction, I've run out of What?? questions for the moment, so we'll have to make do with a 'why'. The question is, why should you connect the ballast of a fluorescent light in the neutral of the supply?

Answer to September's What??

The answer is $25. Let's call the cabinet C and the TV parts P. Then P + C = $300 and P - C = $250. Adding these two equations gives 2P = $550, or P = $275. Therefore C = $25. ❖

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How they made the Atomic Bomb - 2

Continued from page 23

was definitely FUBAR. It was eventually buried without ceremony at Trinity; out of sight, out of mind.

Death, destruction

Atomic energy had arrived. Atomic death had arrived.

A 'Little Boy' gun-type atomic bomb was assembled and dropped un-tested upon Hiroshima on August 6, 1945. It snuffed out the lives of 78,000 people. Three days later a Fat Man, just like the one at Trinity, was dropped on Nagasaki. Another 100,000 people died. The Japanese surrendered on August 14.

Back at Los Alamos, there was jubilation over the success of the gadgets and their part in ending the war. But, over the years, the enormity of what had happened began to sink in. I mentioned in the first article that I felt some resistance among the old timers to my snooping around the Los Alamos story; a re-opening of old wounds. There is public bravado, but I feel there is also private sadness.

This feeling was expressed quite openly by Australia's Sir Mark Oliphant, during a recent television interview on the ABC.

Sir Mark was right in the thick of atomic bomb development; he was instrumental in supplying the fissionable material that eventually annihilated nearly 200,000 people.

When questioned about it, Sir Mark's face tensed; he was very, very bitter about his own involvement in what seemed like a good idea at the time.

Sir Mark later became a strong campaigner for peace, using his considerable influence to try to right the wrongs of the past, and prevent any further uses of nuclear weapons. He has been joined by world opinion, and we have only recently seen the end of the Cold War and the easing of nuclear tensions among countries. Many nuclear weapons are being systematically destroyed.

Should this trend continue, we may some day find atomic bombs relegated to the history books. The reactors that allowed bombs to be produced are now producing power for peaceful purposes, and isotopes for medical diagnosis.

This may or may not be a good thing; the debate still rages. But as for the Little Boys and Fat Men and all their descendants, may they vanish forever from the face of the earth. And good riddance to them! ❖

Experimenting

Continued from page 79

no *voltage* amplification, but it does give *current* amplification and a low output impedance — both of which we need to get a good volume from our low impedance loudspeaker.

The reason for diode D5 is to isolate the preamp supply rail from the main stage, so that, even if the main supply voltage drops below 9V, its supply will remain constant. (Smoothing capacitor C5 also helps to do this.) The battery voltage will drop below 9V when the class AB power amplifier draws a larger current than the battery can supply, at full voltage.

Finally, resistors R9-R11 help stabilise the circuit. Resistor R9 gives 100% negative DC voltage feedback between output and input of the complete three-transistor amplifier.

Note that the amount of AC feedback will vary, depending on the setting of the VOL trimpot RV2. And resistors R9 and R10, by being connected to the emitters of transistors Q5 and Q6, give a small amount of local negative feedback which helps to compensate for current variations caused by temperature changes, different transistor gains, etc.

Most modern amplifier circuits use power transistors connected in class AB mode to provide the final stage of the amplifier. For this reason, next month we will be featuring a more powerful general-purpose class AB power amplifier. This will provide a handy module which we will use for add-on amplification for any future projects which generate a low-level audio output.

As you have been reading through the two parts of this project, have you wondered what the word 'ultrasonic' actually means? It literally means 'beyond sound' — a sound wave with a frequency *above* the range of frequencies that the human ear can hear. This range is usually quoted as 20Hz to 20kHz; so 'ultrasonic' means any sound wave with a frequency higher than 20kHz.

Transparencies

As usual, a high contrast, actual size transparency (negative) for the PCB used in this circuit is available for only $2. This will allow you to etch your own printed circuit board. This special price applies for transparencies for all projects in this series only. Write to *EA*'s reader services division.

Happy experimenting — and please send us your comments on the circuits we have published, as well as ideas for future projects. ❖

50 and 25 years ago...

'Electronics Australia' is one of the longest running technical publications in the world. We started as 'Wireless Weekly' in August 1922 and became 'Radio and Hobbies in Australia' in April 1939. The title was changed to 'Radio, Television and Hobbies' in February 1955 and finally, to 'Electronics Australia' in April 1965. Below we feature some items from past issues.

October 1943

Infra-red solves crimes: When documents are examined or photographed under ultra-violet or infra-red rays, the result is often unpleasant for the forger. Areas on which erasions have been effected stand out boldly; inks which match perfectly in normal light may appear quite different on the developed plate.

Ultra-violet radiations are usually produced by gaseous discharge tubes, infra-red with ordinary tungsten filament lamps in conjunction with a filter.

Improved aero engine: American aircraft experts have perfected an engine which enables planes to fly 10,000 feet higher than at present. Britain's latest Spitfire can fight at 40,000 feet. The new engine is a 1500 horse-power Rolls-Royce. A supercharger automatically provides a supplementary supply of oxygen for the plane at higher altitudes where the air is rarified.

October 1968

Phone service for computers: The Australian Post Office is to introduce a service called Datel which will enable computers to communicate with each other over telephone lines. A device known as a data modem (modulator-demodulator), attached to the subscriber's existing telephone service, accepts information from computers or other data processing equipment, and converts it into a signal form suitable for transmission through Post-Office facilities.

Liquid crystal technology: RCA Laboratories has demonstrated a number of experimental liquid-crystal devices that could lead to potentially important new electronic products. The devices included an all-electronic clock with no moving parts and a high-resolution picture display.

Development of the new liquid-crystal screen resulted from two discoveries, namely, that certain liquid crystals can be made opalescent, and hence reflective, by the application of an electric voltage; and that the temperature range over which this occurs — originally confined to only a few degrees at high temperature — can be expanded to cover a range from below freezing to the boiling point of water.

Large scale integration: While the electronics industry is still seeking to cope with — and adapt to — integrated circuits, a new term is appearing in technical literature. It is Large-Scale Integration (LSI).

As its name implies, LSI is integrated electronics on the large scale — whole arrays of hundreds and eventually perhaps thousands of fully inter-connected integrated circuits of the type now available individually. The value of LSI lies primarily in compacting very large repetitive arrays of elementary logic functions.

It has been suggested that an IC array becomes an LSI one when there are more than 100 interconnected, individual integrated circuits in it. However, Fairchild Semiconductors has introduced what it calls an LSI array which contains only 32 circuits. ❖

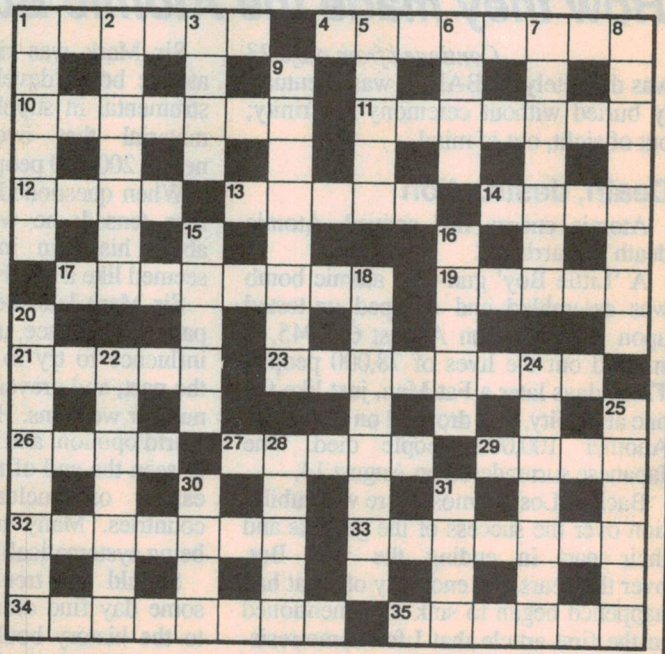
EA CROSSWORD

ACROSS

1. Type of disk. (6)
4. Errors. (8)
10. Part of a transceiver. (7)
11. Knowledge gained from previous R&D. (4-3)
12. An aberration of a lens. (4)
13. Local AC frequency in Hz. (5)
14. Expo for new electronics, etc. (4)
17. Bursts of energy. (8)
19. What is associated with I^2R? (5)
21. Donor of famous prize. (5)
23. Resistance wire. (8)
26. Said of a disconnected line. (4)
27. British television pioneer. (5)
29. A way-out instruction. (4)
32. Closed a switch. (7)
33. This is associated with Neptune. (7)
34. Convert from analog form. (8)
35. Part of a record player. (6)

DOWN

1. James ——, prize-winner for electron bombardment of gases. (6)
2. Most efficient. (7)
3. Male connectors. (4)
5. A TV's P-in-P has an —— picture. (5)
6. Adjust for best effect. (4)
7. Skilful knowledge. (4-3)
8. Computer programs. (8)
9. First name of EA's managing editor. (8)
15. Assemble a kit. (5)
16. Visible effect in passage of electrons. (5)
18. Common use for passive infra-red detectors. (8)
20. Not checked, revised or corrected. (8)
22. Interfering rhythmically, as waves do. (7)
24. Former unit of magnetic flux. (7)
25. Forms in which matter exists. (6)
28. Renowned brand of signalling lamp. (5)
30. Manifestation seen on oscilloscope. (4)
31. Ergonomically important angle for a keyboard. (4)



SOLUTION FOR SEPTEMBER 1993

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REVIEW: YOKOGAWA'S 7562 6.5-DIGIT DMM, 7651 PRECISION DC 'MINI CALIBRATOR'

LOCAL FIRM DEVELOPS INTEGRATED ROBOTIC SYSTEM FOR FORD'S FALCON ASSEMBLY LINE

SHARP OFFERING OWN VERSION OF 'NEWTON'

DESIGNED & MANUFACTURED IN AUSTRALIA: ALFATRON'S NEW 'A SERIES' PRINTER SHARERS, FEATURING 42K CPS THROUGHPUT, BI-DIRECTIONAL PARALLEL PORTS...

NEWS HIGHLIGHTS

SYSTEM TO BROADCAST FAXES

Videotext and other systems which transmit data during the vertical blanking interval of TV signals have not been a notable success in the past, but an international consortium believes it has found the answer. Instead of using vertical-interval signals to send text and low-grade graphics for display on a TV screen, Faxcast Holdings has developed a system which allows standard Group 3 fax messages to be broadcast simultaneously to virtually any number of recipients — a very difficult and costly thing to do using standard telephone lines.

The Faxcast system uses a low-cost decoder which connects to a standard TV receiver and can pass the received fax messages to a standard fax machine, a PC with a fax card or a printer. The decoders will be rented to subscribers at around US$20 per month, and subscribers will be charged on a per-page-received basis.

Faxcast is launching the system this month in Hong Kong, and is targeting publishers, financial institutions, government departments and major corporations. It says that the system will be much cheaper than the traditional fax service for large users, especially for long-distance transmission. Once the system is established the company plans to use satellite TV to cover huge geographic areas at low cost.

LOCAL SUCCESS IN ROBOTICS

A locally developed $2.5 million, high technology robotic assembly which will significantly increase productivity of car body assembly was officially handed-over to Ford Australia by the Federal Ministry for Industry, Technology and Regional Development, Alan Griffiths, in Melbourne recently.

The state of the art system was built by Lewis Australia, a locally owned leading supplier of customised manufacturing and automation systems for industry and one of the 700 'Emerging Exporters' highlighted in the recent McKinsey study.

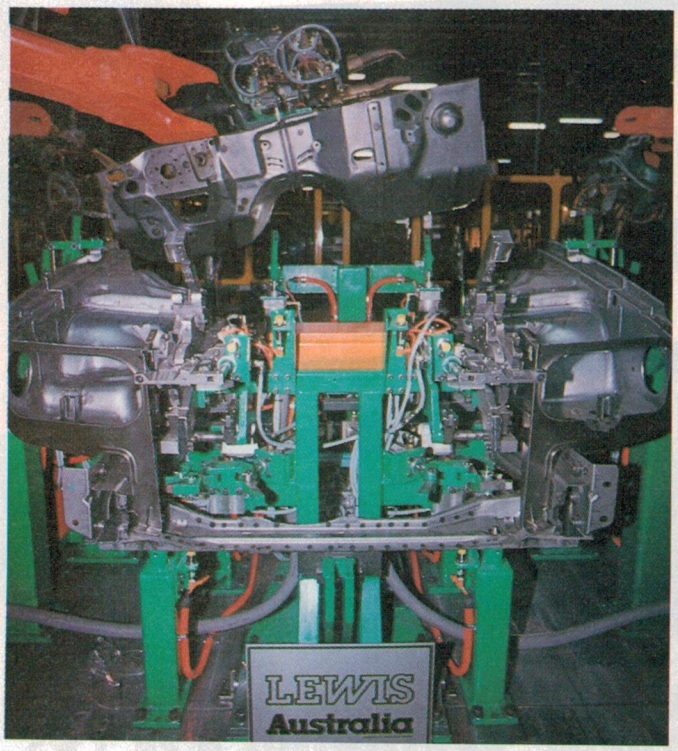
The world-class robotic system was developed for Ford Australia to assemble and spotweld the front section of the body for the Ford Falcon range of vehicles, and is claimed to increase productivity in this section of the assembly line by 40%.

In this project Lewis formed a strategic alliance with the Robotics Division of ABB Industry Australia. ABB are world leaders in robot-based automation.

Mr Griffiths congratulated both Lewis and Ford on their successful completion of this system. "The system incorporates computer controlled welding robots combined with specially developed fixturing, to provide flexibility for future model changes or conversion for other functions. Flexibility in the range of applications the machinery can serve is vital, given the size of the Australian motor vehicle manufacturing industry.

"In this system, the robots are used for both handling, assembly and welding functions to achieve maximum use of the equipment. Computer simulation was used to verify the technical feasibility of the system and optimise layout and work sharing between the robots prior to manufacture."

"The technology employed in this innovative project has already attracted interest from overseas manufacturers and could generate much needed export dollars for Australian industry."



Above: Federal Minister for Industry, Technology and Regional Development Alan Griffiths (right), pushes the button on the high technology robotic assembly system with Lewis Australia Managing Director, Mr Howard Evans (left).

Left: The welding component of the $2.5 million, high technology robotic assembly system.

UNSW SYSTEM FINDS AIRCRAFT FAULTS

Civil aviation authorities in both Australia and the USA are to support further development of a Portable Holographic Testing System (PHTS) developed at the University of NSW's Department of Aerospace and Mechanical Engineering, University College, Australian Defence Force Academy. The system is capable of making three-dimensional images (holographic interferograms) of an object, and in the aviation industry it would be used for the detection of structural faults in aircraft.

The system is being developed by Associate Professor John Baird, Senior Technical Officer Bob Clark and a team from the Department, and the project R&D will be supported by the FAA by up to $250,000 per year for the next five years.

Professor Baird said experiments have indicated that structural faults, such as that in which the side of a Boeing 737 'unzipped' in 1988, could be detected at an early stage with the PHTS.

"The PHTS is capable of detecting cracks well before they emerge from under the heads of rivets, and before they are detectable by other means," he said.

OBITUARY

A sad gap in the local electronics industry has been created by the sudden death of Mr Steven Calder, the manager of Hycal Electronics in Parramatta. Hycal carried out design, servicing and manufacture, and advertised its services in *EA* for some years. Mr Calder had also been an occasional correspondent to our 'Forum' column.

Steve Calder served for many years with the Navy and with Qantas, and started his business initially repairing kits. In partnership he also managed Hycal Servicon, which was involved in refrigerant recovery repairs.

He had recently married and had a bright future, but this changed suddenly when he died in mysterious circumstances on June 26 — the victim of an unknown assailant.

Electronics Australia extends its condolances to Mr Calder's wife and family, in their sad loss.

SHARP OFFERS OWN PDA DEVICE

Sharp Corporation, which is manufacturing Apple's new 'Newton' PDA in Japan, has announced its own PI-7000 Expert Pad, described as a revolutionary new handheld Personal Digital Assistant that does away with the need for a keyboard. Like the Newton, the PI-7000 allows information to be handwritten onto a display screen, and transfers it into type characters.

Sharp believes that the Expert Pad is set to become an indispensable tool for users who are not familiar or comfortable with keyboards, as well as being adopted by those who use technology on a daily basis. Users simply write their own notes, memos or letters, onto the notepad screen, using the Expert Pad's pen. The information is then automatically transferred into type characters. The same method can be used to take advantage of all the traditional personal organiser functions of the system.

Hand-drawn diagrams — such as maps — are easily converted to neat graphics and geometric forms. In addition, the Expert Pad uses infra-red wireless technology, that allows users to send information — such as a confidential note, or an appointment calendar — to another Expert Pad.

These facilities are simple to master. Link software allows information to be

sent to and from a variety of personal computers, including the popular Apple Macintosh computer. Messages can also be sent from the Expert Pad to facsimile machines, to printers, and to public electronic mail services.

Also under development for the Expert Pad are application software development tools designed for corporate use which will allow customised document forms to be created on a Macintosh or IBM PC.

The Expert Pad was developed in partnership with Apple, and combines Sharp's leading expertise in LCD technology and touch-sensitive displays with Apple's software expertise. With the Expert Pad, Sharp becomes the first licensee of Apple's new Newton technology.

0.25uM TECHNOLOGY ON THE WAY

IBM, Siemens and Toshiba have commemorated the first anniversary of their companies' alliance to jointly develop a 256-megabit DRAM, using quarter-micron semiconductor technology. On hand were the project leaders John Abernathey of IBM, Hans Schuster-Woldan of Siemens, and Haruo Nakatsuka of Toshiba.

After planning and organising the project in January 1993, a development team from the three companies was located in East Fishkill, NY, 60 miles north of New York City. Since then, the development team has successfully fabricated test chips using quarter-micron technology. The 256Mb chip will be capable of storing more than 10,000 typed pages of text in less than two square centimetres. The development is due to be completed in the late 1990s.

AUSTRALIAN BROADCASTING SUMMIT

The 1993 Australian Broadcasting Summit is planned for the Hilton Hotel in Sydney on November 11 and 12, 1993, just after the ITU Symposium in Geneva. An expert panel of speakers will provide attendees with an up-to-date and in depth information on Pay TV and other coming developments in broadcasting, and their likely impact in Australia.

Speakers are to include Cameron Dunlop (CEO Broadcom Australia), John Bigeni (Federal Head, TV Technical Services, ABC-TV), Colin Knowles (Director of Planning, ABA), Dr Bernard Smith (Section Manager, Optical Network Section, TRL), Rosemary Sinclair (Director of Strategic Development, ABC) and media commentator Fred Brenchley.

Further information and registration forms are available from the organiser IIR Conferences, Level 9, 33 Berry Street, North Sydney; phone (02) 929 5366, fax (02) 959 4835.

ABC SATELLITE CONTRACT TO S-A

Following the successful installation of a large new earth station for the ABC in Darwin to beam Australian programs to Asia and Pacific areas, Scientific-Atlanta Australia won another major contract from the ABC valued at approx $600,000 for the supply and installation of a series of receive-only earth stations in other Australian capital cities.

The new ABC earth stations, which have now been installed in Canberra, Perth,

Hobart and Adelaide, receive program material via satellite and distribute the signal to city and regional area viewers. Scientific-Atlanta says the earth stations will save the ABC 'vast amounts of money' through providing a distribution network on a state-by-state basis, without calling on a third party distributor.

The Managing Director of Scientific-Atlanta Australia, Mr Steve Dean said: 'Although there was a very tight time frame from the signing of the contract to the supply, installation and commissioning of the dishes, Scientific-Atlanta had the resources and the engineering skills available to fulfil the contractual obligation'.

The dishes have been designed for broadband operation to cover all ku-band satellite frequencies.

MORE SUPPORT FOR UNSW SUPERCON R&D

Metal Manufactures has just announced its continued funding for research into superconductivity, by a team of material scientists at the University of New South Wales.

Subject to continuing satisfactory performance against the plan and extension of the existing Research Collaboration Agreement, Metal Manufactures has agreed to continued funding for the years 1994 and 1996 inclusive.

The research team at the University of NSW, School of Materials Science and Engineering, established in 1987 and headed by Professor Shi Xue Dou has been sponsored by Metal Manufactures since conception. So far, the team of researchers has notched up seven world firsts, filing three patents and publishing more than 75 papers.

SOLAR CHALLENGE HAS 55 ENTRIES

Entries for the 1993 Daido Hoxan World Solar Challenge are finalised and 55 vehicles are expected to start in Darwin on Sunday 7 November.

The winning vehicle will take approximately five days to reach Adelaide, travelling at more than 70km/h over the 3004km distance. Some of the world's largest companies — including car makers — and famous educational institutions are involved.

Announcing the entries, organiser Hans Tholstrup said the fact that 85% are from overseas seems to indicate that 'at this stage, our economy cannot support a financial increase for energy research in Australia."

"Also, interest from places such as Japan is far greater than in this country, where for the next eight years or so we are self-sufficient in oil."

Tholstrup believes that Australia has a very dedicated group of people who are concerned with alternative energy. "However, overseas interest in the World Solar Challenge has increased by 400% since the first event, while Australian entries remain static. Yet an Australian — Dr Martin Green of the University of NSW — has invented the world's most efficient solar cells. Several overseas entrants will use them."

The World Solar Challenge is held every three years. The inaugural event in 1987 was won by the GM Sunraycer. General Motors in the United States, went on to develop the Impact — a prototype electric commuter vehicle designed for everyday public use — using technology and knowledge gained in the World Solar Challenge.

General Motors-Holden remains the only Australian manufacturing company to sponsor the World Solar Challenge. As well as being the event's official vehicle supplier, the Holden's sponsorship extends to aiding two Australian universities and two schools with funding and support vehicles.

WINNERS OF OUR YAESU COMPETITION

We had a huge response to the 'If Only They'd Had A Yaesu' competition we ran in the July issue — many thanks to all of the readers who joined in and sent an entry. The large number of entries gave the judges a very difficult time, too. But finally, after much deliberation, we've been able to pick the grand winner of that shiny new Yaesu FRG-100 Communications Receiver (valued at $999), and the nine runners-up:

The winner of the FRG-100 is Mr David Williams, of Ringwood in Victoria, for his amusing story about the way Cook might have been deterred from claiming Australia for Britain. Congratulations to Mr Williams, and he'll be receiving his receiver very shortly.

The nine best runner-up entries, which were all very close to the winning entry in the judges' opinion, were:

- Ms Marigold Robinson of Nanango, Queensland
- Mr Craig Urquhart of West Pymble, NSW
- Mr Leonard Aheam of Curtin, ACT
- Ms Leanne Carter of Orange, NSW
- Mr Ray Darnell of Richmond Hill, NSW
- Mr Callum Hoogesteger of Glenorie, NSW
- Mr T. Stahlfest-Moller of Townsville, Qld
- Mr Charles Hill of Pearce, ACT
- Mr J Symons of Woodend, WA

We'll be publishing all of these entries in the very near future, as promised, and paying a fee of $40 to each of their contributors. Meanwhile, our congratulations to all of the winners, and our thanks to Yaesu's distributor Dick Smith Electronics for their sponsorship of this very successful competition.

AUSTRALIAN SUCCESS

Australia's 15 exhibitors at CeBIT '93 in Hannover equalled the previous best sales results achieved by exhibitors at the Austrade stand, at the world's leading computer hardware, software and telecommunications trade fair.

Over the previous six CeBIT fairs, Australian firms had historically reported on excellent flow of business inquiries and successful deals concluded as a direct result of the fair, an average of A$2 million per exhibitor.

This year was no exception and, according to Michael Abrahams, Austrade's European Project Manager for CeBIT '95, the exhibitors reported sales arising from this year's fair are expected to exceed A$52 million. This includes some A$3.5 million worth of orders received during the eight-day fair.

"It comes as no surprise that most of the exhibitors are planning to be back at CeBIT next year and again in 1995 when we assume the role of Partner Country," says Michael, completing his fifth fair as Austrade stand manager.

He noted that the firms exhibiting on the Austrade stand were not alone at CeBIT '93. "We counted over 30 more locations around the 480,000sq.mtr. exhibition area where Australian companies were represented by their agents, distributors or licence holders," he said.

The fair this year was seen as an important opportunity for Australia's IT industry and Austrade, who are the major sponsors of the nation's Partner Country, promotion at CeBIT '95.

IRIDIUM SEWS UP INITIAL FINANCING

Motorola Inc has announced it has successfully obtained binding investor commitments and initial cash payments for financing of Iridium Inc — closing the first round equity offering of US$800 million. Shares in Iridium were purchased by telecommunications operators and industrial companies from around the world, with Motorola itself purchasing a minority interest.

Iridium investors, in addition to Motorola, include the following companies or their affiliates: BCE Mobile, a

NEWS BRIEFS

- ***Marconi Instruments*** has been appointed the exclusive distributor in Australia for Pragmatic Instruments of San Diego, USA.
- ***KC Electronics*** has appointed Nick Horley as its Marketing Manager. Nick has worked at KC Electronics for seven years. Garry Sarandis has retired and is moving overseas.
- Australian software developer ***Megatec*** has opened a sales and technical support office in Brisbane, headed by Manager Mark Dimech and Technical Support Manager Charles Petersen. The new office is located at 3rd floor, 1 Eagle Street, Brisbane 4000; phone (07) 360 0299, fax 221 2100.
- Honeywell has appointed ***BEP Controls and Instrumentation*** as distributor in Australia and Papua New Guinea for its control and instrumentation products.
- ***Philips Scientific & Industrial*** is now marketing throughout Australia the Rustrak product range, centred around the Ranger II microprocessor-based data logger.
- Melbourne-based ***Spectra-Physics*** has appointed Roger Christiansz as National Product Manager for its Swedish- made AGEMA range of infra-red thermographic equipment. ❖

subsidiary of BCE Inc, the largest telecommunications provider in Canada; Muidini Investments BVI Ltd, a consortium of private investors based in Venezuela; Lockheed Corporation and Raytheon Company, US aerospace and industrial electronics companies, Sprint Corporation, the only US telecommunications company that provides long distance, cellular, and local telecommunications services; Khrunichev Enterprise, the Russian Federation's aerospace engineering and manufacturing organisation and producer of the Proton launch vehicle; Nippon Iridium Corporation, a consortium of 18 Japanese companies led by Daini Denden (DDI) and Kyocera Corporation, and including Sony, Mitsubishi Corporation, Mitsui Company, seven regional cellular operators, and others; China Great Wall Industry Corporation, one of China's largest industrial companies, which provides satellite launch services and manufactures the Long March launch vehicle; and United Communication Industry Company Ltd, a major cellular and paging operator in Thailand.

Iridium will establish a global satellite communications system that will allow customers to call or be called anywhere on earth, anytime, using a network of 66 low earth orbit satellites.

HPM RECALLS SAFETY SWITCHES

HPM Industries has voluntarily recalled its 5000 series of Portable Electresafe Safety Switches, as the switches may fail to operate under certain extreme and abnormal conditions.

safety switches being recalled are identified as follows: all switches with serial numbers printed in blue; all switches with serial numbers printed in brown with serial numbers greater than 210,000. Members of the public who have purchased a 5000 series HPM Portable Electresafe Safety Switch should telephone: 008 80 7000 to arrange for the return of the switch for modification. The modification of the safety switch will be made free of charge.

HPM Industries' Managing Director Mr Peter Simon said that the voluntary recall is to improve the Electresafe 5000 series performance under all earth fault conditions.

BT, formerly British Telecom, has recently launched Europe's first domestic Videophone service, heralded as 'the most significant breakthrough in personal communications since the introduction of the telephone'. Sound familiar?

STANDARDS FOR MD AS PC DATA STORE

Sony Australia has announced the development of standards for MiniDisc (MD) DATA, a new compact data storage medium offering high data storage capacity for personal computer applications. The MD DATA standard has been developed to meet the computer industry's growing need for storage of large amounts of data. The standard is based on specifications established for the MiniDisc audio system just released.

"Typically, floppy disks have been used for everyday PC data storage because of their compact size and cost effectiveness. However, the need to add graphics, as well as audio information to documents created on a PC has led to the demand for a removable data storage medium capable of handling large amounts of data," said Sony's New Business Development Manager Garry Beauchamp.

"With advantages such as system size, cost and ease of use, Sony believes MD DATA will become the next generation of data storage technology," he said. The most outstanding feature of MD DATA is its ability to accept three different disc types in a single drive mechanism:

Pre-mastered MD DATA (MD-ROM): Ideal for electronic publishing and pre-recorded software applications;

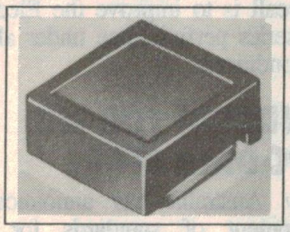
Recordable MD DATA (rewritable MD): A completely rewritable magneto optical disc, ideal for personal data storage applications; and

Hybrid MD DATA (partially rewritable MD): A disc that is partially pre-recorded with sections of the disc recordable by the end user. The pre-recorded sections of the disc cannot be erased: ideal for interactive applications.

MD DATA is compact and portable with a size of only 68mm x 72mm x 5mm. It offers 140MB memory capacity. This provides storage for approximately 2000 frames of still images on one disc. It also has a data transfer rate of 150kB per second, allowing the disc to store CD full motion video. ❖

NEW PRODUCTS

SMD coils have narrow tolerance



Murata Manufacturing has released the LQS33N series of high performance chip coils with narrow inductance tolerance. The series is ideally suited for oscillation circuits and LC filter circuits in video and communication equipment.

The LQS33N employs a magnetic shield design, in which a wound chip coil is covered with a ferrite sleeve, to ensure usable inductance. This feature is combined with highly accurate trimming, thus achieving a narrow inductance tolerance of +/-2% or less.

The series also features less interference with peripheral circuits, permitting high density packaging. The use of the newly developed high frequency ferrite assures a high Q factor at high frequencies, so that high performance circuits can be configured to minimise loss.

The series offers an inductance range of 1uH to 100uH, with a tolerance of +/-2% for its wound SMD coils. This eliminates the need for fine adjustment of oscillation circuits or LC filter circuits.

For further information circle 242 on the reader service coupon or contact IRH Components, 1-5 Carter Street, Lidcombe 2141; phone (02) 364 1766, fax 647 1545.

Subminiature electret mics

Knowles Electronics has released the EY series of integrated subminiature electret microphones. The objective has been to improve product quality and reliability, consistency and production leadtimes. In addition to meeting these objectives, Knowles also announces that the EY range will be offered at reduced prices. The mics feature low vibration and high electro-acoustic sensitivity, tight sensitivity tolerance and low noise (26dB max). The EY range of microphones is the latest addition to a range of acoustic transducers, which includes subminiature microphones, speakers, receivers, beepers and vibration transducers.

For further information circle 244 on the reader service coupon or contact Micromax, PO Box 1238, Wollongong 2500; phone (042) 266 777, fax 266 602.

Frequency changer

California Instruments of San Diego, USA, has introduced its model 1201WP Frequency Changers, which provides a low cost, convenient source of 1200VA international power. It can operate and test products which are exported to countries with different voltage and frequency requirements to those normally available at the manufacturing site.

Output voltage is adjustable from five to 260V, at frequencies of 47 to 500Hz, while output power is delivered to a rear panel barrier strip so that products can be conveniently powered both during development and prior to shipment. A digital display allows convenient monitoring of RMS output voltage, frequency and RMS load current.

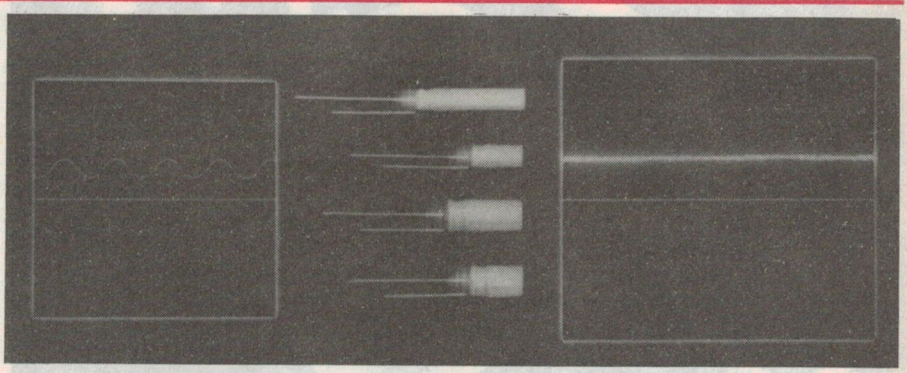
For further information circle 245 on the reader service coupon or contact Obiat, 129 Queen Street Beaconsfield 2015; phone (02) 698 4775, fax 699 9170.

Power factor corrected switching power supply

Pioneer Magnetics' new series PM3187 is a multiple output switching power supply for computer mainframes, desktops, peripherals, process control, telecom and ATE. Incorporating built-in 0.99 power factor correction (PFC) and a 127 x 203 x 311mm enclosure, the new supply provides output of 1340W over the full range of 90 - 264V AC, with no input strapping or switching required.

Equipped with 'active resistor emulation' type PFC, the unit is designed to meet the most stringent international safety and EMI standards. This includes IEC 555-2, which places limits on line harmonic current for power supplies rated higher than 300 watts. Because they effectively eliminate third harmonic currents, the PFC equipped switchers are ideal for installations where neutral line current exceeds recommended values, due to waveform distortion caused by typical off-line units. Additional features include +/-0.25% line/load regulation, +/-0.1%

Very low impedance electrolytic capacitors



Philips Component's new RVI 136 series of radially leaded non-solid electrolytic capacitors exhibit very low impedance — even at high frequency — and excellent ripple-current capability.

The new series is an extension to Philips' non-solid electrolytic range, which includes the popular RLI 135 series. With an ESR significantly lower than equivalent capacitors of the RLI series, the new capacitors are ideal for smoothing, filtering and buffering in power supplies and DC-DC converters. A 4700uF/16V capacitor with a case size of 16 x 35.5mm, for example, has an ESR at 100kHz of less than 0.022 ohm and can handle ripple currents up to 4.5A at 85°C. As an additional benefit, the very long lifetimes of these new products, between 3000 to 10,000 hours (depending on case size), assures outstanding reliability in operation. The capacitors are supplied in values from 47 to 8200uF, with a tolerance of +/-20%. Rated voltages range from 10 to 63V.

For further information circle 241 on the reader service coupon or contact Philips Components, 34 Waterloo Road, North Ryde 2113; phone (02) 805 4455.

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DC Accuracy (1 year)	0.0035%
AC Accuracy (1 year)	0.06%
Maximum input	1000Vdc
Reading speed	1000/sec
Resolution	100 nV,10nA 100 μΩ

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voltage stability, self contained forced air cooling, remote sense, no on/off overshoot, completely isolated output and automatic soft start. Overvoltage, overload, overtemperature and reverse voltage protection are standard. The operating temperature is 0 to 50°C at full load.

For further information circle 246 on the reader service coupon or contact Amtex Electronics, PO Box 285, Chatswood 2057; phone (02) 805 0844, fax 805 0750.

Overload thermistors

Siemens now has available a range of PTC thermistors, with exceptionally high impulse strength, tested with a standard 1000V pulse. These ceramic components exhibit high long term stability and defined switching performance without hysteresis, making them ideal for applications in telecommunications such as telephones and fax machines. The thermistors are also available with a +/-2% tolerance classification for digital and analog switching systems.

These new overload protection thermistors, designed S-1022, S-1023, S-1024 and S-1025, have a nominal resistance of 10 to 70 ohms, depending on the particular type, and are suitable for voltages up to 245V.

For further information circle 249 on the reader service coupon or contact Siemens Electronic Components, 544 Church Street, Richmond 3121; phone (03) 420 7716.

Fast 100W solder station

Scope has released a soldering system that offers 100W of power in five seconds, with temperature control through a thumb switch.

This heavy duty solder tool — coded SSPSU — is aimed at the electrical maintenance and repair technician who is often faced with a broad range of light through to heavy soldering tasks. The station can deliver 100W of power through a small 4V iron, and also has a 75W pencil available as an option.

For further information circle 243 on the reader service coupon or contact Scope Laboratories, PO Box 63, Niddrie 3042; phone (03) 338 1566, fax 338 5675.

Masthead amp has four inputs

The F-AMB640 from the European manufacturer FAGOR is a truly sectorised, fully screened masthead amplifier, totally built on a die cast alloy housing. It features separate inputs and amplifiers for VHF, and low, mid and high UHF bands. Each of these four individual inputs has its own gain control pot, allowing the user to adjust the level on VHF by up to -25dB and on UHF up to -19dB, individually. The unit also features two UHF notch filter trimmers that can be adjusted and peaked to any point along the UHF band. A -30dB test port that is built into the amplifiers allows the installer to carry out any of the above adjustments with the greatest of ease. The amplifier comes fitted with an FM stop filter to eliminate interference problems in Band III VHF.

For further information circle 247 on the reader service coupon or contact MMT Australia, 7 Amsted Road, Bayswater 3153; phone (03) 720 8000, fax 720 8055. ❖


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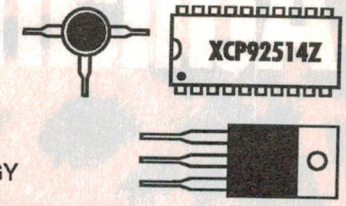


KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY

New 3V logic families

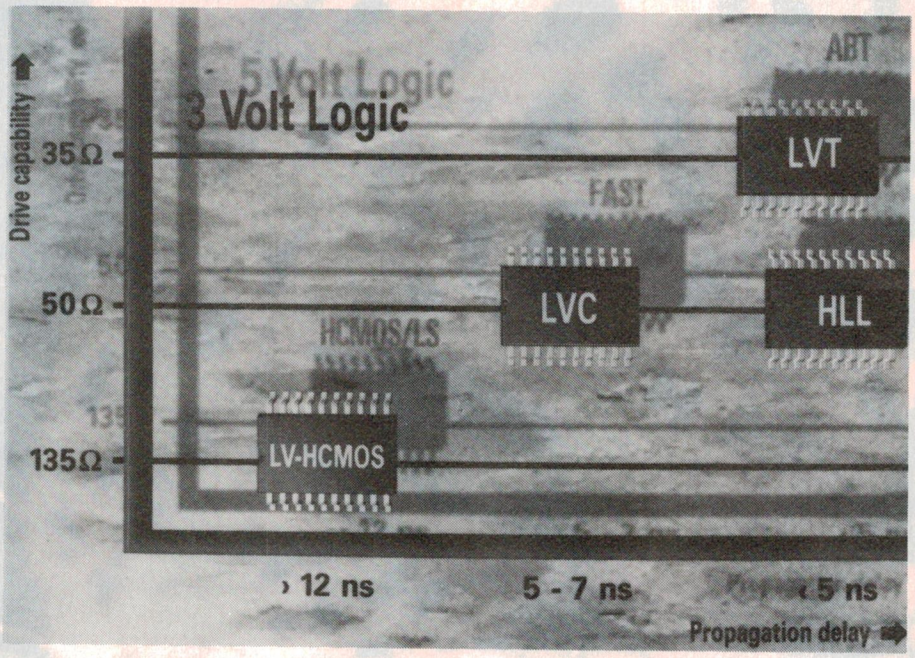
Four new ranges of high speed logic ICs have been launched by Philips Semiconductors, specifically to meet the demands of an increasing number of fast, low voltage applications. Designated the LV, LVC, HLL and LVT series, the four new ranges make fast, low power 3V logic system design a reality.

The LV family was developed as a low voltage HCMOS range of devices, which will operate at low power while achieving the same speed and drive of 5V HCMOS products. With a typical propagation delay of 8ns, it is based largely on Philips' existing HCMOS range of logic ICs.

LVC (Low Voltage CMOS) is a low voltage family with speed and output drive comparable to bipolar 5V FAST logic circuits. LVC offers the very low power consumption typical of CMOS devices. The family features standard TTL pinout, and a 1.2 - 3.6V supply voltage. Applications include telecommunications and portable equipment.

The HLL (High-speed low-power, low-voltage) series runs twice as fast as FAST, yet consumes half the power. This is a completely new sub-micron family which can buffer fast 3.3V processors to RAM banks and peripherals. Octal buffers have a typical propagation delay of 2.5ns.

LVT (Low Voltage Technology) is a low voltage 3.3% BiCMOS logic family ideally suited for bus driving applications. The family features hot insertion, TTL pinning, high current drive and typical propagation delays of 4.5ns. Applications include telecommunications and backplane equipment.

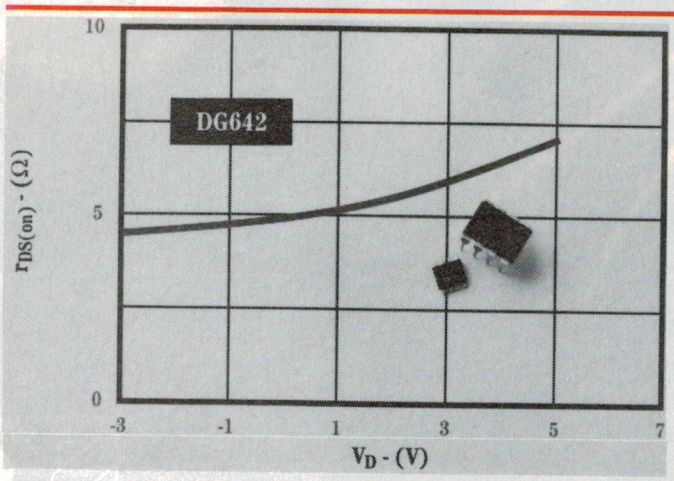


Typically operating on 3.3V power supplies, the three new CMOS families will operate effectively on supplies which drop as low as 1.2V.

For further information circle 272 on the reader service coupon or contact Philips Components, 34 Waterloo Road, North Ryde 2113; phone (02) 805 4455.

High speed DDS

Qualcomm's new high speed, single chip Q2230 Direct Digital Synthesiser (DDS), has a maximum system clock rate of 85MHz. This allows it to synthesise output sinusoids from 0 up to 42MHz when combined with a Qualcomm digital to analog converter (DAC). This synthesiser topology is perfect for applications



CMOS video switch

Siliconix has released monolithic CMOS analog switches with on-resistance below 10 ohms. The new switches allow designers of professional video equipment and high precision test instruments to replace electromechanical relays with more durable, reliable, and energy-efficient semiconductor devices. Typical $r_{ds(on)}$ for the new DG641 and DG642 is eight and five ohms respectively.

Designed for switching high frequency analog and digital signals, the DG641 and DG642 provide minimum signal crosstalk (-87dB and -85dB at 5MHz), low insertion loss, and negligible non-linearity distortion. With a 500MHz bandwidth, the new devices are optimal for switching DC, audio, video, HF, VHF, and UHF. The flat frequency response reduces group delay when switching digital streams, and preserves high signal fidelity when switching broadband signals.

With their high current handling capability (75mA and 100mA), the devices are ideal for switching current sources in ATE applications; and they offer faster response when driving capacitance loads such as digital buses. The low RC time constant offered by these switches makes them ideal not only for switching video, but also for RF signal applications.

For further information circle 271 on the reader service coupon or contact IRH Components, 1-5 Carter Street, Lidcombe 2141; phone (02) 364 1766, fax 647 1545.

tions that require fast frequency switching, good signal quality and low cost.

The Q2230 DDS consists of a frequency control interface, a 32-bit phase accumulator, a 15-bit sine lookup converter, and a 12-bit DAC output. The frequency control interface is CMOS compatible, and can be programmed in parallel, for fast frequency hopping (output latency of <14 system clocks), or serially, which allows the designer to minimise control circuitry.

The 32-bit phase accumulator provides better than 20mHz (millihertz) of frequency resolution over the full output frequency range of 0 to 42MHz. If higher frequency resolution is required, the Q2230's phase accumulators can be stacked to achieve an effective 64 bits of resolution. This results in a frequency resolution of 4.6pHz (picohertz) with an 85MHz clock.

The 15-bit sine lookup table provides low phase-function spurious levels, while the 12-bit DAC output allows the designer to make use of high performance DACs for low amplitude quantisation noise performance, with typical spurious levels of -65dB, or better.

Typical applications for the Q2230 DDS include communications, terminals and instrumentation, baseband transmitters and receivers, HF radios, frequency agile radios and synthesisers, clock generators, and digital demodulation. And the typical dissipation is 980mW, operating at 85MHz.

For further information circle 275 on the reader service coupon or contact Veltek, 18 Harper Street, Burwood 3125; phone (03) 808 7511.

Low on-resistance SMD power FET

Motorola has announced an advanced high cell density power field-effect transistor with less than 10 milliohm on-resistance. This dramatic reduction in on-resistance is claimed to be 32% lower than the lowest available competitive devices. The new HDTMOS power FET process has been combined with the surface mount D2Pak to achieve this very low on-resistance.

The high cell density process of six million cells per square inch allows a 9.5mohm, 50V rating in the MTB75NO5HD power FET, packaged in the D2PAK. Maximum constant current is 75A, maximum power dissipation is 150W, and operation up to a maximum junction temperature of 175°C is possible.

The MTB75NO5HD power FET achieves a power dissipation reduction of greater than 60% for a given current level, using only the specified surface mount area and no heatsink.

The extremely low power losses that result from this new technology will benefit portable, battery-powered equipment by being able to use fewer or smaller components while handling the same power levels in a surface mount package.

Cellular phones, portable computers and even automobiles are primary applications for these devices. Also, because of the very low on-resistance and the fast switching characteristics of its intrinsic diode, the part is also well suited for synchronous rectification applications in high efficiency converters.

This technology opens the possibility of eliminating heatsinks and significantly reducing the size of electronic modules. SPICE data is available for each new device.

For further information circle 277 on the reader service coupon or contact Motorola Australia, 673 Boronia Road, Wantirna 3152; phone (03) 887 0711.

Low noise dual op-amp

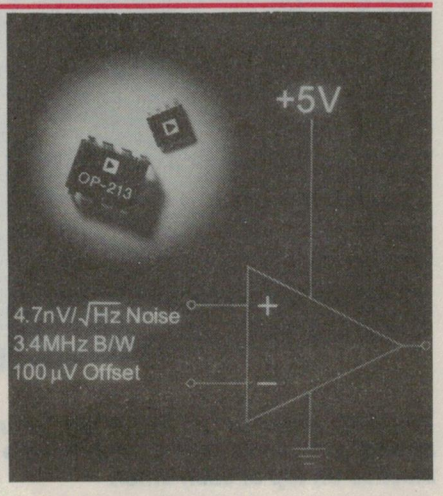
Analog Devices' OP-213 dual operational amplifier claims to offer the lowest voltage noise and drift specifications of any single supply amplifier. Operating from power supplies between +4 to +36V or +/-2 to +/-15V, the OP-213 features 5nV/√Hz voltage noise (25% of competitive devices), 100uV offset voltage, and guarantees 0.8uV/°C voltage drift (0.2uV/°C typical).

The op-amp is well suited for systems with internal self-calibration designed to compensate for initial offsets and for gain, but unable to compensate for temperature drifts and noise.

The OP-213 is optimised for those parameters that cannot be calibrated, so designers can take advantage of the op-amp's superior analog performance, along with the latest digital correction systems. Applications include digital scales, strain gauges, battery operated equipment and multimedia.

The dual OP-213 is unit gain stable, and has a typical gain-bandwidth product of 3.4MHz. Slew rate is typically 1.2V/us. The input common-mode range includes the negative supply and to within 1V of the positive supply over the full operating range.

Output voltage swings also include negative supply in dual supply applications, and go to within 1V of the positive rail.



The OP-213 is a good match with high resolution sigma-delta ADCs and DACs. In such systems the weight of an LSB is generally very close to the noise floor, and all elements in the signal chain, including the amplifier, must be selected carefully for noise performance.

If the system is operating from a single supply, then attaining the greatest signal swing is also an issue.

For further information circle 276 on the reader service coupon or contact NSD Australia, Locked Bag 9, Box Hill 3128; phone (03) 890 0970.

13MHz 3V DSP chip

Analog Devices has introduced the ADSP-2103, a 3.3V powered digital signal processor (DSP) that operates at 13MHz. It dissipates just 30mW during typical operation, and only 83mW maximum, when fully active (i.e., worst case).

In addition to being faster and consuming less power than comparable devices, the ADSP-2103 claims to be the first DSP to offer software control of two modes of reduced power operation.

As developers of portable products seek to minimise power consumption and increase battery life, they are moving to low voltage, low power semiconductors. To meet this requirement, Analog Devices uses transistor size reduction plus design enhancements to allow the ADSP-2103 to attain its low active-power specifications while still maintaining its high 13MHz performance. An extended instruction set provides an 'idle' mode which enables programmable slowing of clock operation, thus reducing power consumption to less than 10mW in the stand-by state.

Future design enhancements will bring stand-by power consumption to less than 1mW, with quick resumption to full-speed operation. Additional transistor shrinkage is planned to improve operating speed to 20MHz.

For further information circle 278 on the reader service coupon or contact NSD Australia, Locked Bag 9, Box Hill 3128; phone (03) 890 0970. ❖

Power Supply Review:

TES-6100 0-30V 3A lab power supply

Jaycar has available a new power supply from the TES company, which would suit anyone requiring a basic heavy-duty bench unit. This solidly-built model can supply a continuously adjustable 0-3A current over the full 0-30V voltage range, and features constant voltage and current controls.

by PETER MURTAGH

First impressions of the TES-6100 are that the power supply has a nicely uncluttered front panel, dominated by two easy-to-read voltage and current meters. The various controls — located below the meters — include a power switch, fine and coarse voltage controls, a current control, and '+', '-' and 'GND' output terminals. Two LEDs indicate whether the supply is operating in constant voltage (CV) or constant current (CC) mode.

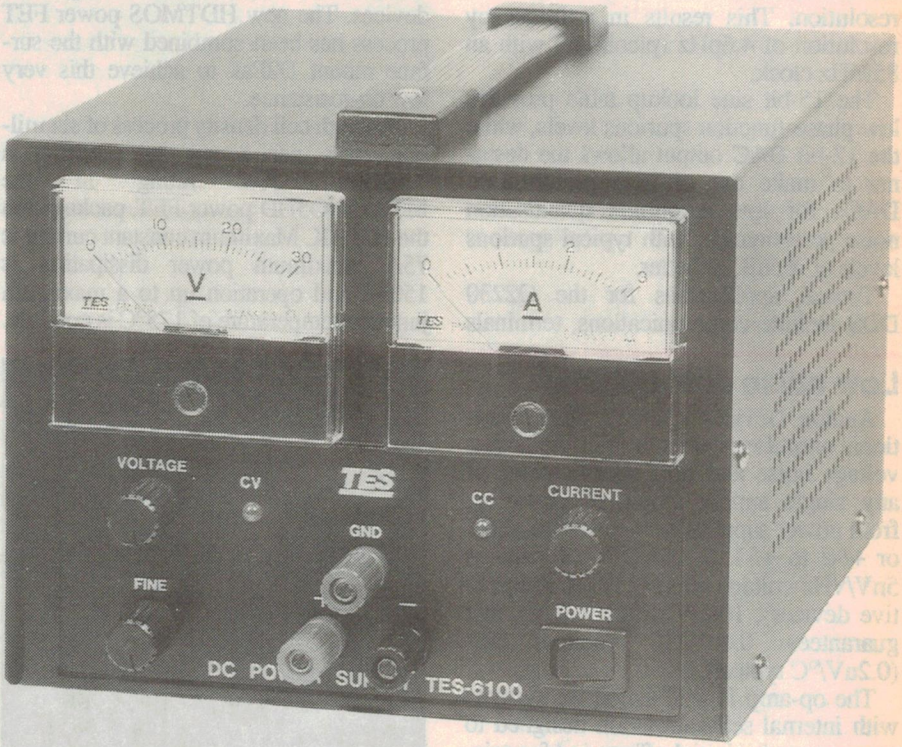
The specifications quoted for the unit are: input voltage 110V or 220V, ±10% (50/60Hz); output voltage and current 0-30V and 0-3A, respectively; ripple <2mV RMS; and noise <1mV peak-to-peak for all settings. The load regulation varies from a low of -8mV for 0-1A @ 10V DC to a high of -20mV for 0-3A @ 30V DC.

There are two voltage control knobs: the coarse control varies from 0-30V while the fine control range is approximately 0-3V. A third knob sets the current limiting. If both the voltage and current knobs are set to zero, then the CC LED comes on, indicating that current limiting can be set almost right down to zero.

As noted earlier, the supply operates in either constant voltage or constant current mode, so either the CV or CC LED is always on. It uses a relay to switch between higher and lower voltage taps on the transformer as the output voltage rises above or drops below about 15V.

Because any unnecessary overhead must be dissipated by the voltage regulator, this technique lessens energy wastage by halving the overhead provided for lower voltages. On the top range, the unit produces about 50V to be able to maintain its 30V level at high currents.

The power supply weighs 5kg, its dimensions are 177(W) x 155(H) x 305mm(D), and it comes with an IEC mains cord and a set of test leads. The unit is housed in a black metal case with a folding carry handle on top. Because the output of the power supply is floating, it is possible to join two TES-6100 units in series to give access to voltages up to 60V, if required.



The front panel of the TES-6100 features easy-to-read panel meters, and well arranged controls. The folding handle on top allows similar power units to be stacked on top of each other.

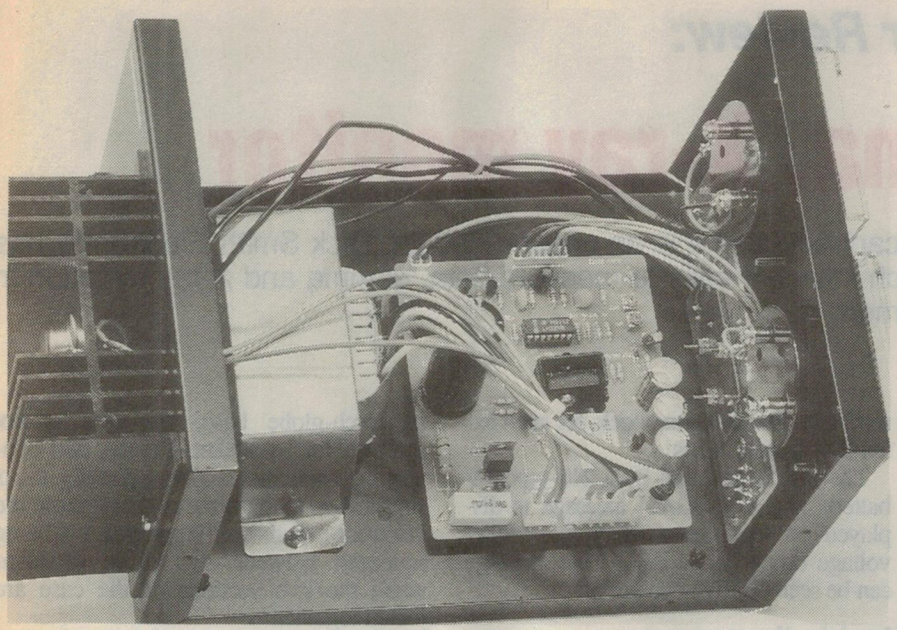
Inside the case

When the lid of the supply is removed, the inside appears quite empty (more so than it appears in the relevant photo). If the PCB were mounted vertically, then the depth of the case could be significantly reduced. Even though the transformer was securely bolted to the case, its flanges were bent considerably — allowing it to rock back and forward. Obviously the unit sent to us for review had suffered rough treatment somewhere along the way!

Two trimpots (seen in the same photo at the top right corner of the PCB) allow the two meters to be adjusted. The instruction leaflet gives clear instructions on how to do this.

Trying it out

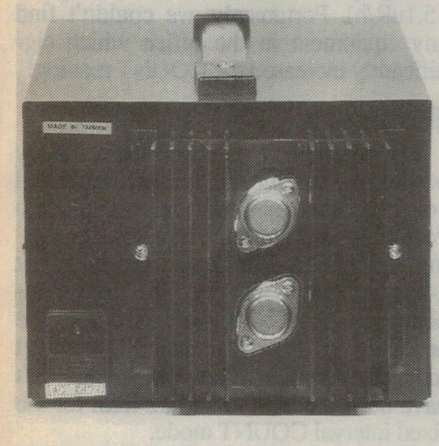
The line regulation was tested with the supply delivering 1A at approximately 10V. When the line voltage was 240V AC, the output voltage measured 9.67V on an APPA 98 DMM. This voltage dropped to 9.65V (-0.2%) when the line voltage was



The view inside the case shows the large amount of spare space, while the heatsink further adds to the length of the case. Note the bent flange on the transformer base (see text).

reduced to 220V (-10%), and rose to 9.69V (+0.2%) when it was increased to 260V (+10%).

Next we checked the load regulation. We did this by comparing the unloaded output voltage with loads drawing various currents, making certain that the current limiting was not activated. The manual quotes the load regulation accuracy as <±0.1V for all loads. Our measurements confirmed that this was so, though the figure was much smaller for most readings; e.g. at 10V our DMM reading stayed at 10.00V from 0-3A. The greatest deviation occurred when operating near the high voltage mark of the two ranges of the transformer: for 30V (0.1V) and for 15V (0.02V). The latter was for currents >1.5A and before the transformer tap switching point.



The two 2N3055 power transistors sit on the large heatsink needed for this robust 3A at 30V power supply. The unit is powered via an IEC mains lead.

The ripple was measured at 3mV (its quoted figure is <2mV RMS), which rose to 6mV when current limiting was activated. Most supplies sacrifice the ripple rejection to control a current overload, so this rise was expected. When we tried to measure the noise level, it was too low to register (quoted as <1mV peak-to-peak).

We also checked the accuracy of the two panel meters against our DMM, using a load which drew currents from 0.5 - 3.0A. The voltmeter over-read by 6.6% at 5V, decreasing to 3.2% at 29V, and the accuracy improved after the relay switched in the second tap on the transformer.

The ammeter accuracy varied a lot more — under-reading by 9% at the lower end of the scale and only 0.7% at the top. This accuracy decreased at the relay switching point. However, such levels of inaccuracies are typical of most analog meters.

We were also interested in how constant the 'constant voltage' and 'constant current' really were. Most times the CC feature is used as current limiting to protect the power supply and circuitry attached, but sometimes you might wish to use it as a constant current source.

Firstly the constant voltage. The voltage remained quite constant with increasing current, caused by altering the load, especially at the top end of each of the two voltage ranges. The maximum variations were +0.02V at the 5V setting (0.4%), and -0.03V at 15.5V (0.2%) — just after switch-over. On the 10V setting, the meter variation was only 0.01V (0.1%). For the constant current, the unit performed similarly. No change in meter readings was noticed at lower voltage levels, and the maximum variation was 0.02A (2.03 - 2.05A) for the varying load at 25.5V. So the power supply could be used to provide a reasonably accurate constant voltage or constant current source.

Summarising

The TES-6100 is a well-built, basic DC power supply. With its ability to deliver a full 3A at 30V, it packs quite a punch. It is very easy to use and to read the meters, which should make it a very useful bench supply. As mentioned earlier, the depth of the case could easily have been shortened by mounting the PCB vertically — allowing it to sit comfortably on shallower shelves.

Unfortunately, the accompanying manual is written in typical 'Taiwanese English', though what the text is trying to say is clear in most cases. The 'Rate of stability for overload: <±0.1V', however, left us puzzled.

Jaycar is selling the unit at all its stores for $279.50, which we consider to be a very reasonable price. ❖

Radiation Detector Review:

Beta, Gamma, X-ray monitor

Nuclear radiation is particularly scary because it is an unseen danger. Dick Smith Electronics has released a handheld monitor which makes it easy to measure beta, gamma and X-ray radiation in your house, workplace or environment.

by PETER MURTAGH

We live in a naturally radioactive world, bombarded by cosmic radiation and surrounded by naturally occurring radioactive elements. However, the level of this naturally occurring background radiation varies considerably depending on location, and often is increased by industrial activities. To measure the actual level in any locality you need a Geiger counter.

The Kapo RX-669D monitor is such a counter. It includes a Geiger-Mueller tube, which detects beta and gamma radiation by capturing the gas particles which are ionised by this radiation. Electronic circuitry then counts the number of ionised particles, and the result is displayed on a 3-digit LCD screen.

Because X-rays also ionise the gas in the Geiger tube, the unit can also be used to measure this form of radiation. But the 'manual' (a foldout sheet of paper) states that the count displayed is only accurate for a cobalt-60 gamma source — for other radiation sources it only gives relative, rather than quantitative readings.

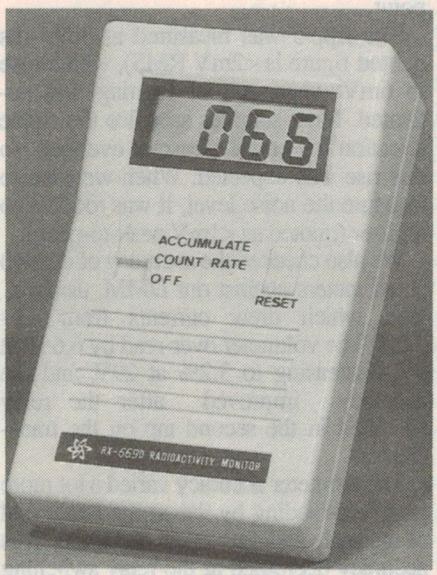
The detector tube has a sensitivity of 200uSv/y (microSieverts per year) or 2.52uR/h (microRoentgens per hour). As a safety precaution, the unit sounds an beeping alarm if the measure radiation is greater than an annual radiation dose of 5mSv/y (milliSieverts per year) or an hourly radiation exposure of 63uR/h. These values are the resident standard set by the ICRP (International Commission on Radiological Protection). Interestingly, a 1964 textbook quotes the accepted exposure level as 1.77mR/h, almost 30 times as large as the current standard!

You can measure the radiation level in two different ways. The first method is called 'COUNT'. It counts the number of radiation particles which reach the Geiger tube over a 64s interval. At the end of this time a continuous beep indicates that the count has finished. If the slider switch is set instead to 'ACCUMULATE', then counting continues indefinitely. This allows a more accurate reading of background radiation, which needs to be averaged over a longer time interval. You will need some external form of reminder, like an alarm clock, for such extended measurements.

The unit is powered by a 216-type 9V battery, and a 'LOBAT' message is displayed on the screen when the battery voltage drops below 7.3V. This message can be seen briefly at power off.

Inside the case

By removing four self-tapping screws, the two sections of the plastic case easily come apart. Everything, except the buzzer, is connected to the front section. Two PCBs and the battery enclosure occupy



nearly all the internal space, roughly a third each. The first PCB is fastened at the top to the back of the LCD display, while the second is in the centre, behind the slider switch and the reset button, leaving the bottom for the battery. The Geiger tube is located in a channel along one side.

This detector tube looks very much like an elongated torch globe, especially as it has the same type of brass base with a screw thread and insulated tip connection. Its glass envelope is cylindrical in shape, with a diameter of around 10mm and a length of 75mm. The first electrode is a thin metal spike which runs down the centre of its entire cylinder, while the second electrode is the brass base. Despite its torch-globe base, the tube is not screwed into a socket. Rather, two connecting wires are soldered directly to its side and tip to make the connections to the electrodes, and it is supported by being squeezed between two piece of foam when the two sections of the case are joined together.

The back section of the case has two sets of holes. A long thin series is located directly below the whole length of the Geiger tube, and so acts as a radiation window; while a star-shaped pattern increases the volume of the beeper.

Conversion factor

Because the monitor directly displays the radiation count, you need to multiply that number by a conversion factor to calculate the radiation dosage. For the 64s COUNT this factor equals 740pR/h (pico-Roentgens per hour), while for ACCUMULATE the average reading per minute is multiplied by 790pR/h.

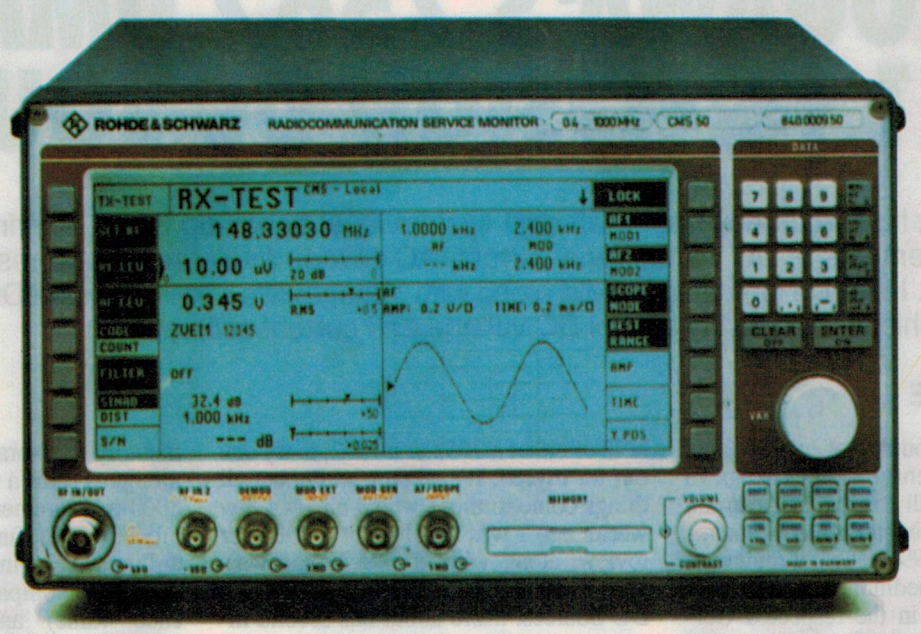
For example, we measured the radiation in the *EA* office. With the monitor immediately in front of a computer screen, the COUNT mode gave a reading of 24 (which converts to 17.8uR/h); and a 30 minute background reading with ACCUMULATE gave a count of 572 (an average per minute of 19.1, which gives 15.1uR/h). Fortunately, we couldn't find any equipment in the office which significantly increased the COUNT reading!

Summary

We were unable to check the accuracy of the unit since we don't have a calibrated cobalt-60 source. However, the unit is a very light and compact monitor, measuring 125 x 77 x 37mm and weighing just 140g without its battery. The only complaint we have with the monitor is the necessity to use a calculator to convert 'count' to 'dosage'. This feature shouldn't have been too hard to add, at least for the fixed interval COUNT mode.

The Kapo RX-669D radioactivity monitor is available from all Dick Smith Electronics stores (Cat. No. Q-1402) for $119. ❖

The one feature we cut down on our New CMS50 Comm's Tester...



... the price!

The new CMS50 Radio Comms tester is an economy version of the popular CMS52 for tight budgets. To save cost, specifications are less stringent and some of the standard features of the CMS52 have become options. However the CMS50 is a full function tester covering 0.4 to 1000MHz. It incorporates the same facilities as the CMS52 – digital scope, spectrum monitor and off-air receiver.

The front panels of the two instruments are identical, featuring a large, high resolution LCD screen with backlighting and full graphics capability. A clear menu structure gives fast access to all facilities using soft-keys. Manual measurements can be stored in 'learn' mode to provide fully automatic test runs with optional hard copy print-out.

Main features:

- RF synthesizer from 0.4 to 1000MHz, 50Hz resolution with AM, FM, øM and multi-tone modulation.
- Two modulation generators – 20Hz to 20kHz (0.1Hz resolution).
- SELCALL and DTMF encoders.
- Cellular AMPS and MPT1327 signalling (optional).
- Extensive measuring capability including – RF Counter, 50W (100W optional) Power Meter, Modulation Meter, SINAD and S/N, Distortion, AF, DTMF Decoding, Oscilloscope etc.
- Wide range of filters – high-pass, low-pass, band-pass, notch etc. plus selectable IF filter.
- Optional IEEE-488, Centronics, RS-232C interfacing.

Call us for a CMS50 brochure and to arrange a demonstration

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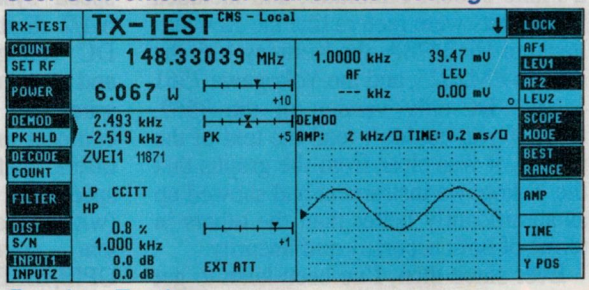
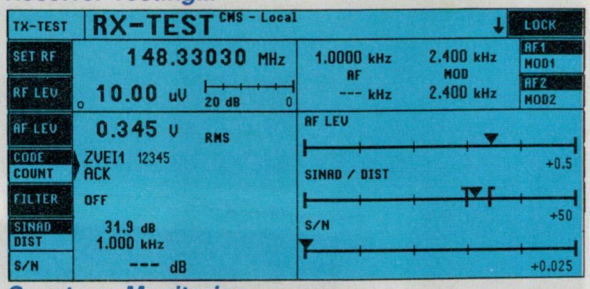
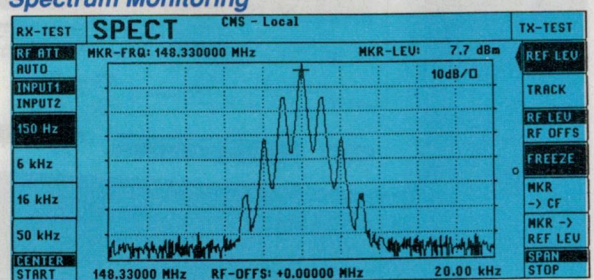


Receiver Testing...



Spectrum Monitoring



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4th Floor, 320 St Kilda Road, Melbourne VIC 3004

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YOKOGAWA'S 7562 DMM, 7651 PRECISION DC SOURCE

The 7562 is a high accuracy true 6-1/2 digit system level benchtop DMM, offering very stable and linear measurements of DC voltage and current, AC voltage and current, and resistance (both two- and four-wire). Here we look at the DMM along with Yokogawa's 7651 precision DC voltage and current source, which is effectively a 'mini DC voltage and current calibrator'.

by JIM ROWE

Up until a couple of years ago, Japanese instrument maker Yokogawa wasn't all that well known in Australia for its digital multimeters. But I remember back in June 1991 seeing a review of 10 different medium-to-high level benchtop DMMs, in the respected German magazine *Elrad*. The reviewer had checked 10 different instruments against a Fluke 5700A Calibrator, and included in the tests were meters like the Hewlett-Packard HP 3478A, the Keithley 196, the Philips PM2525, and the Yokogawa 7561 — the DC-only version of the 7562. Even if you couldn't read the text of the review, it was clear from the graphs that the Yokogawa instrument had showed up as significantly better than the others in terms of both accuracy and linearity.

Ever since then, I've been keen to get hold of either a 7561 or a 7562, to try one out for myself. It's taken a while, but all things come to those who wait — a few weeks ago I was finally sent a 7562 for review, along with one of Yokogawa's very interesting type 7651 Programmable DC Sources. More about this second instrument shortly.

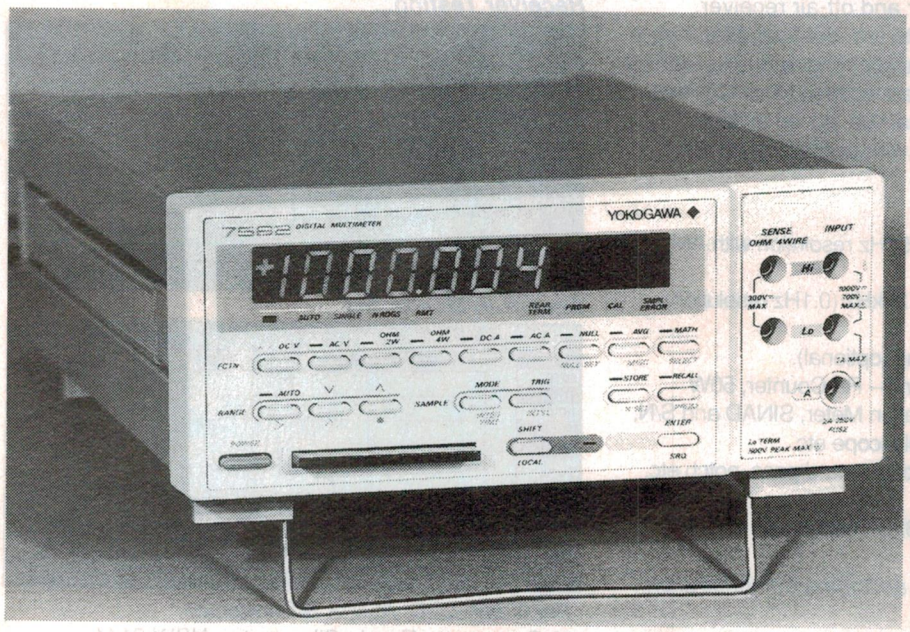
The 7562 is a high accuracy, high speed 'system' type DMM offering true 6-1/2 digit resolution measurements of DC voltage and current, AC voltage and current, and resistance (both two-wire and four-wire). Although quite compact and relatively low in price, it offers features such as measurement speeds as high as 333 samples/second (with reduced resolution), a built-in system communications port (either GPIB/IEEE-488 or RS-232C), internal memory for storage of up to 1000 measurements (plus a socket to store a further 8000 measurements on a memory card), inbuilt maths functions (such as offset nulling, averaging, scaling, dB calculations and comparisons against a reference value) and the ability to be calibrated 'via software', without opening the case.

The case of the 7562 measures 211 x 100 x 330mm overall, and the instrument has an overall weight of 3kg. It has a distinctively styled front panel, with the recessed input terminal jacks on an angled section at the right, facing slightly outwards to keep the test leads away from the front panel. There's an alternative set of input jacks at the rear, by the way, with a changeover switch so that the instrument is also quite suitable for dedicated rack-mount applications.

The display uses highly readable 15mm-high seven segment LEDs for the main 6-1/2 digits, plus smaller (7mm) dot-matrix alphanumeric LEDs for the 'units' display. The latter is a bit weak in comparison with the main digits, but in practice this isn't a problem. A row of small mode indicator legends just below the main display is backlit by further red LEDs, while the top row of primary control buttons and four of the lower buttons are accompanied by small green indicator LEDs.

The control buttons themselves are all of Yokogawa's slim and neat 'lozenge' pattern, with some having a dual function activated by the 'shift' button just to the right of the memory card socket at the bottom. Even the main power switch is a neat slimline button, just slightly larger than the rest at bottom left.

Considering the capabilities of the 7562, the control functions are surprisingly intuitive. All of the main measure-



Yokogawa's 7562 is a true 6-1/2 digit system-level DMM, with a maximum reading of 1999999. It accepts a plug-in memory card for storing measurement data.

ment modes are selected merely by pressing the appropriate button, and this also applies to selection of maths functions like offset nulling and averaging. Automatic range selection is the default when the instrument powers up, but this can easily be disabled simply by pressing the 'Auto' button and selecting the desired range manually using the 'Up' and 'Down' arrow keys alongside.

Incidentally for DC voltage the 7562 provides five ranges, with full-count figures of 199.9999mV, 1999.999mV, 19.99999V, 199.9999V and 1100.000V respectively (500ms integration time). The input resistance on the three lowest ranges is 1Gohm, and on the two highest ranges 10M. Note that the four lowest ranges are capable of giving full 6-1/2 digit resolution with 500ms integration, while the top range is only limited by voltage-breakdown considerations.

There are also five ranges for AC voltage, but here as you might expect the resolution is not as good, at 5-1/2 digits (no doubt due to limitations in the true-RMS AC to DC converter that must be switched in). The ranges here have full-count figures of 199.999mV, 1999.99mV, 19.9999V, 199.999V and 700.00V respectively, with an input impedance of 1M in parallel with 150pF on all ranges. Again the limit on the top range is due to breakdown considerations. AC voltage measurements can be made to 100kHz.

For DC current there are four ranges, in this case with full-count figures of 1.99999mA, 19.9999mA, 199.999mA and 1999.99mA respectively. Here again the resolution is lower than for the voltage ranges (5-1/2 digits), probably due to the tolerance of the shunts.

Similarly for AC current the four ranges are again 1.99999mA, 19.9999mA, 199.999mA and 1999.99mA respectively. AC current measurements can be made to 5kHz.

On the other hand there are no less than *seven* resistance ranges, with full-count figures of 199.9999 ohms, 1999.999 ohms, 19.99999k, 199.9999k, 1999.999k, 19.9999M and 199.999M respectively. As you can see the instrument here provides a full 6-1/2 digits of resolution on the five lowest ranges, and only drops back to 5-1/2 digits on the two highest ranges.

Very flexible

The 7562 is very flexible in terms of measurement sampling or 'integrating' time, offering no less than seven different options in terms of the balance between measurement speed, resolution and averaging out of AC mains hum.

The options are 1.2ms, 2.5ms, 16.7ms, 20ms, 100ms, 200ms and 500ms, with the shortest times giving fast measurements at lowest resolution (4.5 digits), the intermediate times giving medium-speed measurements with averaging of AC mains hum (60Hz at 16.7ms, 50Hz at 20ms and 100ms) and moderate resolution (5.5 digits), and the longest times giving the slowest measurements but the highest resolution (6.5 digits).

Along with the measurement time, you also have a choice of 14 different 'auto' sampling intervals. These can be varied from as frequently as every 3ms up to 1015ms, corresponding to sampling rates from 333 samples per second to around one per second.

Needless to say you can't select these sampling times independently of the measurement/integrating time; the DMM has to be able to perform the measurement and perform its housekeeping before the next sampling trigger occurs. In fact if you have it set to 'Auto Zero' mode, the minimum sampling time must be roughly doubled to cover the increased housekeeping.

Of course there's also a 'single measurement' mode, as well as a mode where the DMM will take a sequence of 'N' samples and store the data in memory.

Incidentally the above sampling intervals are simply those that are built into the DMM, and available in its 'auto triggering' mode. As an alternative you can select *external* triggering, where measurements are made in response to a triggering signal fed in from an external source.

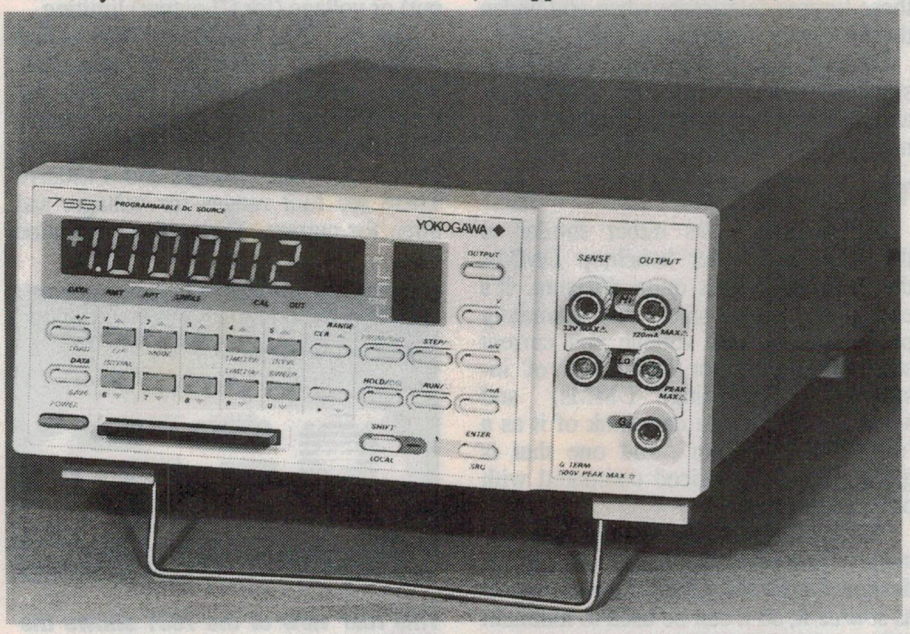
The instrument even has an adjustable time delay between the arrival of the external trigger (a positive-going edge) and its measurement time, to allow for system start-up delays. The delay time can be set anywhere from 0 to 60 minutes, in 1ms units up to 3s and 1s units from 3s to 3600s.

Stable converter

The performance of any DMM is a function of its A-to-D converter, and at the heart of the 7562 is a special 'feedback pulse-width modulation' converter designed by Yokogawa and said to be responsible for its outstanding accuracy, stability, linearity and speed of operation. The converter effectively modulates the duty cycle of an internal 2.4kHz clock signal so that it becomes proportional to the incoming analog voltage, using a four-slope integration technique which cancels out any nonlinearities due to integrator constants, comparator dead bands, etc.

The net result is a rated basic 24-hour DC voltage accuracy on the 2000mV DC range (500ms integrating time) of 0.0025% of reading, plus 10 LSD digits (10uV). This figure extends out at *one year* from calibration to 0.005% of reading plus 15 LSD digits (15uV) — which is very impressive. The other DC voltage ranges are not quite as good, but even the 1000V range with the poorest figure has a rated accuracy of 0.005% plus 10 LSD digits at 24 hours, and 0.016% plus 20 LSD digits at one year — still quite impressive.

Inevitably the accuracy figures for the other parameter measurements are not as good, considering their derived nature (this applies with virtually any DMM). In



Although it may look like a DMM, the 7651 is a programmable DC voltage and current source — virtually a 'mini DC calibrator'.

this case the next most accurate is resistance, where the 20k range offers 0.005% plus 20 LSD digits at 24 hours and 0.012% plus 30 digits at one year, for four-terminal measurement. The other resistance ranges are less accurate, with the 200 ohm range still offering 0.014% plus 50 LSD at one year and the 2M range 0.05% plus 120 LSD for the same time.

(Not surprisingly the two highest ranges have poorer accuracy again, with the 200M range rated at only 2% plus 200 LSD.)

The accuracy for DC current measurements is 0.05% plus 20 LSD at one year for the two middle ranges, with the 2mA range offering 0.05% plus 100 LSD and the highest range 0.1% plus 40 LSD — both at one year.

AC voltage measurement accuracy is quoted only for one year from calibration, and varies from 0.15% plus 100 LSD for the 2V and 20V ranges, out to 0.3% plus 100 LSD for the three other ranges. This is for the basic frequency range of 40Hz - 10kHz; the figures deteriorate when you widen the frequency range down to 20Hz (the lower limit) and up to 100kHz.

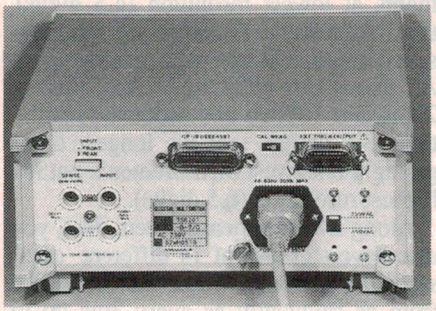
Finally there's AC current, where the combined effects of shunt tolerance and rectifier non-linearity produce the poorest accuracy figures, in all DMMs. Here the two middle ranges provide 0.5% plus 200 LSD from 45Hz - 2kHz at one year, with the lowest range widening slightly to 0.5% plus 250 LSD and the highest range 1% plus 200 LSD. Again these figures deteriorate when you widen the frequency range out to 20Hz - 5kHz.

Overall, though, the rated accuracy and stability of the 7562 are quite impressive, and compare very well with other instruments in the same price range.

The DC source

Although it looks rather similar to the 7562 and other benchtop DMMs, the 7651 is in fact quite different. It's essentially a very stable and accurately programmable DC voltage and current source, designed for calibration of instruments (including DMMs) and similar jobs. So you can think of it as a 'mini DC calibrator', and one that is quite attractively priced compared with other calibrators.

The 7651 is not just a precision power supply, however. Its output circuitry is designed to be able to *sink* current as well as *source* it, so it can be used to maintain either a constant voltage or constant current even with active loads — making it

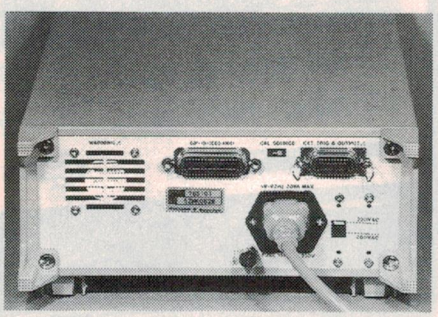


The 7562 has a second set of input jacks on the rear panel, along with the GPIB connector.

suitable for applications like measuring the discharge characteristics of batteries, etc. And as the output circuitry is capable of operating in all four voltage/current polarity quadrants, it can drive both capacitive and inductive loads.

Other features of the 7651 include a bipolar output, which can switch from positive to negative polarity (and vice-versa) without any 'glitches'; the ability to change the output voltage or current to a new value within 10ms (within +/-0.1%); an internal program memory, capable of storing a sequence of up to 50 voltage or current steps, with programmable times for the changes between values ('sweep time') and the values themselves ('interval time'); a socket for a plug-in memory card, which can store up to seven further 50-step programs; an inbuilt GPIB/IEEE-488 or RS-232C interface for computer control; and programmable current (for CV output) or voltage (for CI output) limiting.

Like the 7562 DMM, the 7651 is also designed for software re-calibration, without opening the case. The 7651 can provide an accurately set and very stable DC voltage between -32V and +32V, or a current between -120mA and +120mA. There are four ranges for voltage, and three for current. The setting resolution



This rear view of the 7651 shows the GPIB socket, cooling fan and connector used for external triggering.

over most of the ranges is to 5-1/2 digits, as indicated by the built-in LED display.

The voltage ranges have full-scale values of +/-12.0000mV (resolution 100nV), +/-120.000mV (resolution 1uV), +/-1.20000V (resolution 10uV), +/-12.0000V (resolution 100uV) and +/-32.000V (resolution 1mV), while those for current have full-scale ranges of +/-1.20000mA (resolution 10nA), +/-12.0000mA (resolution 100nA) and +/-120.000mA (resolution 1uA).

For both voltage and current the output level can be set by either keying in the exact value wanted, or by varying the output in steps using increment/decrement keys for each of the digits — a very flexible arrangement.

The rated accuracy and stability of the 7651 are also quite impressive. For the three highest voltage ranges, the 24-hour stability is 0.001% of the setting plus 10uV, 20uV or 50uV respectively (1.2V, 12V and 32V ranges).

The corresponding figures for the 12mV and 120mV ranges are 0.002% + 3uV and 0.003% + 3uV respectively. At one year from calibration the coring accuracy figures are 0.016% of setting plus 120uV (1.2V range), 240uV (12V range) or 600uV (32V range); 0.025% plus 5uV (12mV range); and 0.025% plus 10uV (120mV range).

On the current ranges, the 24-hour stability figures are 0.0015% of setting plus 30nA for the 1.2mA range, 0.0015% plus 300nA for the 12mA range and 0.004% plus 3uA for the 120mA range. One year out the corresponding accuracy figures are 0.03% plus 100nA, 500nA and 5uA respectively.

The output noise of the 7651 is also very low. Over the frequency bandwidth from DC to 10kHz, the rated noise outputs for the five voltage ranges (in ascending order) are 30uV, 30uV, 60uV, 100uV and 200uV peak to peak, while for the three current ranges the corresponding figures are 100nA, 300nA and 3uA peak to peak.

In short, then, the 7651 is a high quality precision DC voltage and current source, which should be very suitable for a wide range of calibration applications in industry and instrument servicing. It should be quite adequate for calibrating the DCV and DCI ranges on the majority of 3-1/2 and 4-1/2 digit DMMs, for example.

By the way the 7651 is in a somewhat longer case than the 7562, measuring 213 x 88 x 350mm. It's also a little heavier, at 3.6kg. It can be obtained in a rear-terminal model if desired.

Trying them out

The people at Yokogawa Australia were able to spare the sample 7562 and 7651 for a couple of weeks, so we could get a good feel for their ease of use as well as their performance.

Basically we found them both very easy to drive from their front panels, thanks to the intuitive control layout. Probably the only thing about the 7562 DMM which took a little while to master was the way you need to adjust the sampling interval when the integration time is changed, in order to neither sacrifice measurement speed nor have the instrument flashing its 'SMPL ERROR' indicator at you. We found ourselves wondering why the minimum sampling interval couldn't be adjusted automatically as you change the integration time, in fact, to overcome this minor hassle...

Apart from that, though, we liked the way the 7562 flashes its model number and currently-set GPIB address at you, when it powers up; the ease with which it can be switched between auto and manual ranging; the maths facilities, such as the 'walking window' averaging and the dB scaling; and the bright, stable display.

Our impressions regarding the 7651 were equally positive. It too flashes its model number and GPIB address at you when it powers up, and turns out to be very easy to use from the front panel. We particularly liked the way you can either key in a complete new output value or change to it in steps, too — plus the convenient output enable/disable button.

We tried hooking both of the instruments up to a PC via one of Binary Engineering's locally-made 'GPIB Smart Cable' (as reviewed in the June issue), and they both turned out to be reasonably straightforward to control remotely.

We don't have any instruments or standards in our lab capable of really checking the calibration of this class of instrument, but comparing them with the instruments we *do* have certainly didn't suggest that they might have been out of spec.

Not surprisingly, we did try checking them against each other. This was of special interest as both instruments were actually 'demo' units, and in each case had gone for well over a year since their last calibration. So a comparison seemed likely to give a good indication of their overall stability in a practical working environment with significant periods between calibrations...

The results of the comparison were indeed an eye-opener. At 199.990mV, they agreed within 0.009%; at 1.9500V, within 0.005%; at 19.995V, within 0.006%; at 1.00000mA, within 0.005%; at 10.0000mA, within 0.01%; and at 100.000mA, within 0.007%. These figures are all with respect to the actual value, and are not only well within the one-year specs for the 7651, but also within the one-year specs for the 7562 as well — only just, in the case of the voltage readings, but well inside for the current readings.

So overall, we were very impressed with both of these Yokogawa instruments. At the quoted current price of $1690 plus tax (it's recently been reduced) for the 7562 DMM, it seems excellent value for money and a particularly good instrument if you're in the market for a genuine 6-1/2 digit system level DMM.

Similarly the 7651 strikes us as a very solid, accurate and stable 'mini DC calibrator', and one that at the quoted price of $3348 plus tax also represents good value for money in a computer-programmable instrument of this standard.

Further details on both instruments are available from Yokogawa Australia, Centrecourt D3, 25-27 Paul Street North, North Ryde 2113; phone (02) 805 0699, or fax (02) 888 1844. ❖

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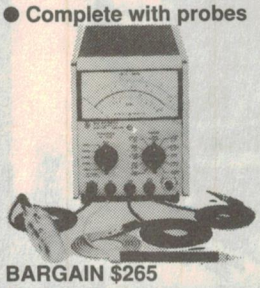

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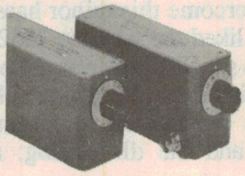

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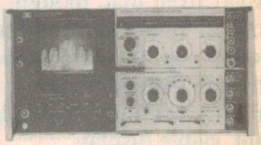

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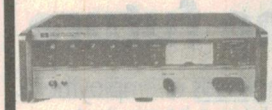

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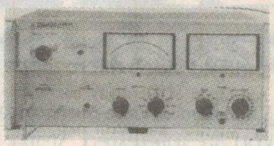

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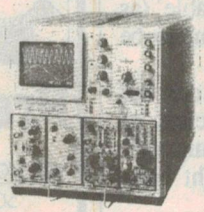

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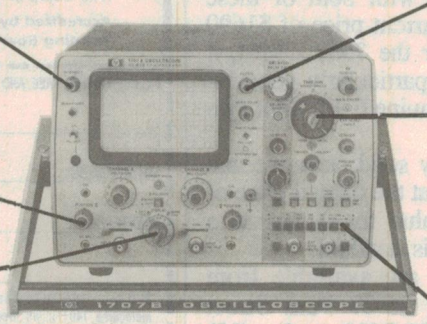

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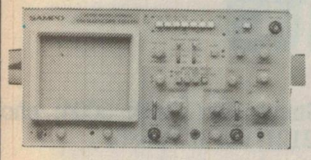

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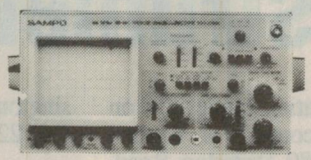

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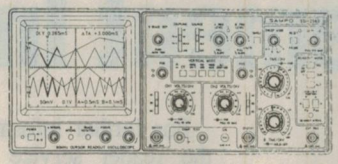

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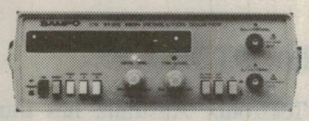

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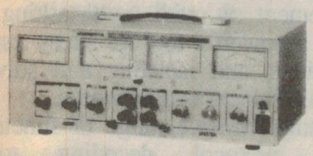

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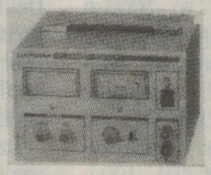

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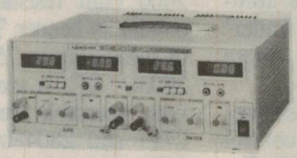

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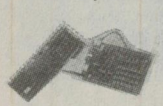

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For further information circle 204 on the reader service coupon or contact Tektronix Australia, 80 Waterloo Road, North Ryde 2113; phone (02) 888 7066, fax 888 0125.

Telecom meter

The American Reliance AR-185T Telecom meter is designed for the professional telecommunications market, where ruggedness and durability are prime considerations in instrument purchases. Features include true RMS level measurement from -51 to +14dBm, noise measurement ranging from -72 to -10dBm using a C-message weighting filter, and 2000 ohm resistance measurement with continuity beeper. The AR-185T is capable of measuring to 750V AC, 200V DC and 200mA DC. A tone generator is included with selectable frequencies of 404, 1004, 2713 and 2804Hz, with a -13dBm and 0dBm output level. Also included is a carry case, and a range of clips to suit different applications.

For further information circle 203 on the reader service coupon or contact Computronics International, 31 Kensington Street, East Perth 6004; phone (09) 221 2121, fax 325 6686.

Ethernet network advisor

Tech-Rentals has acquired the recently released Hewlett-Packard 4981A Ethernet Advisor, and it is now available for hire.

The 4981A is a powerful analysis tool, based on a 486DX processor platform running at 33MHz and featuring a high resolution, full colour VGA flat panel screen and an IBM keyboard. Both screen and keyboard fold down for ease of transportation, making the unit ideal for field operation. It combines a complete measurement set with multi-tasking, to provide a powerful tool for stress testing applications, and isolating and solving problems on local area networks.

Its comprehensive range of functions include protocol decoding tools, stimulus/response testing and statistical analysis. The HP4981A has a powerful multi-task operating system, which allows various measurement to be executed simultaneously.

The Advisor's Fault Finder expert system observes a network's behaviour,

Automatic board tester

Binary Engineering International has released a new, Australian made model ATE called the SMT-2000, which is specifically designed to meet the testing needs of today's electronic manufacturers.

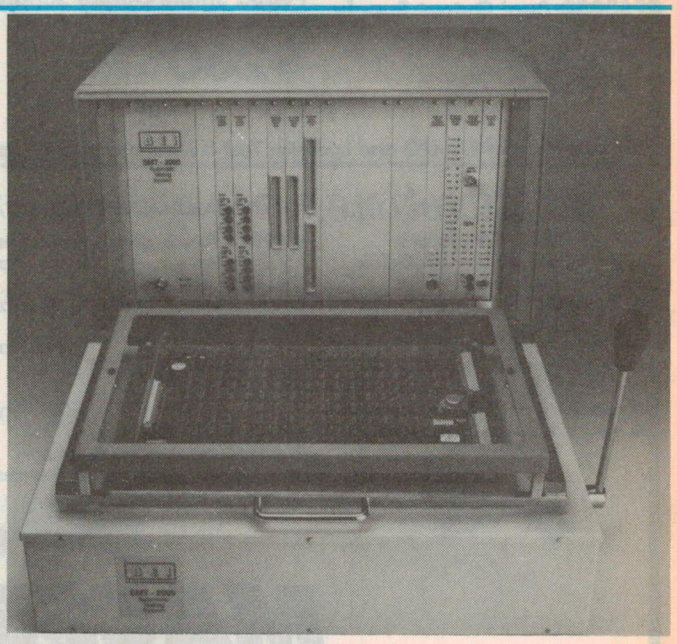
The SMT-2000 is designed for in-circuit and functional testing of surface mount boards as well as conventional boards. In many modern designs conventional probing is expensive or impossible — for these applications BEI has developed StarChecker. This is a technique which can test even high density surface mount boards, without the need for expensive mechanical fixtures or space consuming test pads on the board under test.

Software is written with ease of use in mind, and software modules are available for operation under virtually any Microsoft language, including VisualBasic, QuickBasic, C, C++, etc. Complete analog and digital libraries are available for most functional and in-circuit test routines.

Skeleton programs are supplied to further speed up test program writing. Using the optional Smart Cable adaptor, the SMT-2000 can operate with any PC, including laptops, notebooks and palmtops.

The 100% Australian designed and manufactured SMT-2000 is small and modular, so that both its hardware and software may be readily configured to suit most applications.

For further information circle 220 on the reader service coupon or contact Binary Engineering International, 102/658 Pittwater Road, Brookvale 2100; phone (02) 938 5344, fax 938 5875.



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READER INFO NO. 22

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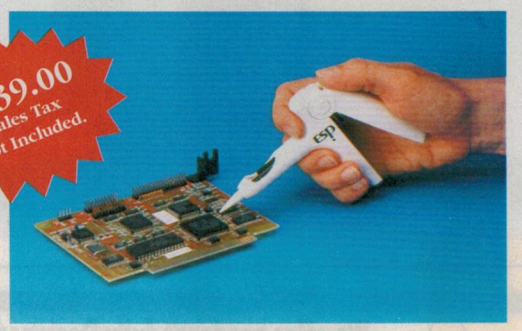
008 030 949

Protel Technology

READER INFO NO. 23

Precision Dot Making Kit for SMT and Field Repairs



The compact Dot.Maker™ kit from ESP contains all of the tools and materials required for SMT and electronic solder joint repair • Ideal for rework stations on mobile field repairs or inspectors • The kit contains Dot.Maker™ precision hand dispenser, assorted solder pastes and flux in prefilled caplettes • Prefilled caplettes can be snapped quickly in and out of the unit • Dots of solder paste are placed exactly where needed, even within fine pitch geometries • Paste and flux provide long tack time and reliable solder fusion • They remain stable without separation for 12 months • VacTweezer™ ensures safe handling and placement of SMD parts without danger to leads or board scratching • Five sizes of interchangeable pad / tips are supplied to handle a wide range of components

ELECTRONIC DEVELOPMENT SALES PTY LIMITED A.C.N. 001 363 480
Unit 2A, 11-13 Orion Road, (P.O. Box 822), Lane Cove NSW 2066
Phone: (02) 418-6999 Fax: (02) 418-6550

ES D

READER INFO NO. 24

forms hypotheses on possible problems and finally reports on its findings. Active stimulus/response tests are used to actually prove conclusively, the existence of each suspected fault. This automatic, active fault finding capability is special to the HP network Advisor.

For further information circle 202 on the reader service coupon or contact Tech-Rentals, PO Box 621, Ringwood 3134; phone (03) 879 2266, fax 879 4310.

160MHz CRO has four traces

Sampo Technology Corp, represented in Australia by Macservice, has released the Sampo SSI-2560 oscilloscope. This is an affordable (approximately A$1500 plus sales tax) oscilloscope with the following major features:

- Dual timebases with speeds to 50ns per division
- Two vertical channels, 5mV to 5V per division
- Four trace display
- Inbuilt read out cursors with 100 point per division resolution for both vertical and horizontal axes
- Measure voltage and difference, time and difference and frequency on screen.
- Flexible triggering options
- Component testing capability

Putting all of these features in a single affordable package is said to bring true laboratory performance and service shop convenience within the reach of even the enthusiastic hobbyist. Deliveries are expected to commence in December 1993.

For further information circle 201 on the reader service coupon or contact Macservice, 26 Fulton Street, South Oakleigh 3167; phone (03) 562 9500, fax (03) 562 9615.

Chart recorders

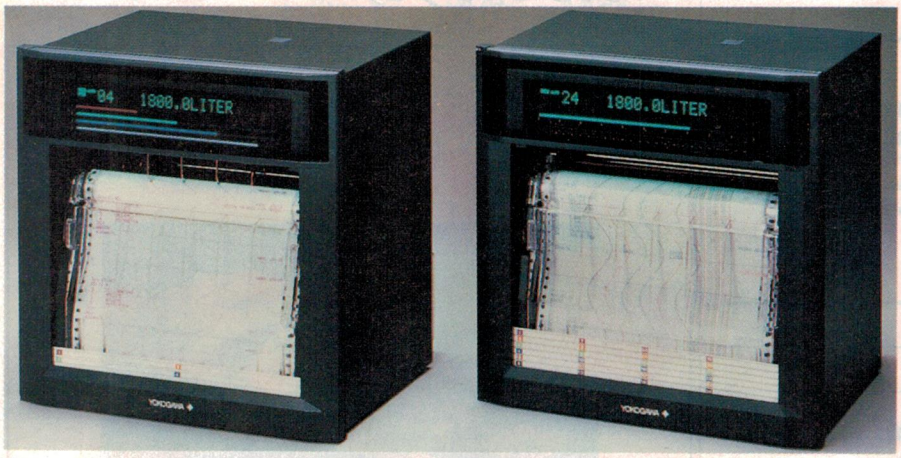
Yokogawa has released two new chart recorders, the uR1000 and uR1800. You can easily program up to four-pen continuous and up to 24 points high speed scanning, DCV, thermocouples, RTD and contact inputs for each channel.

RS422A communications is available, as well as mathematical functions, both general (+, -, SQR, LOG) and statistical (maximum and minimum summation).

There are also IC memory cards for storing setups, versatile alarms (with six alarm types — high/low limit, high/low deviation, H/L rate of charge) and remote control functions.

The rear panel connectors are removable so that a replacement unit can be fitted without removing wires, or for when the unit has to be moved quickly to another location.

For further information circle 221 on the reader service coupon or contact Yokogawa Australia, 25-27 Paul Street North, North Ryde 2113; phone (02) 805 0699, fax 888 1844.



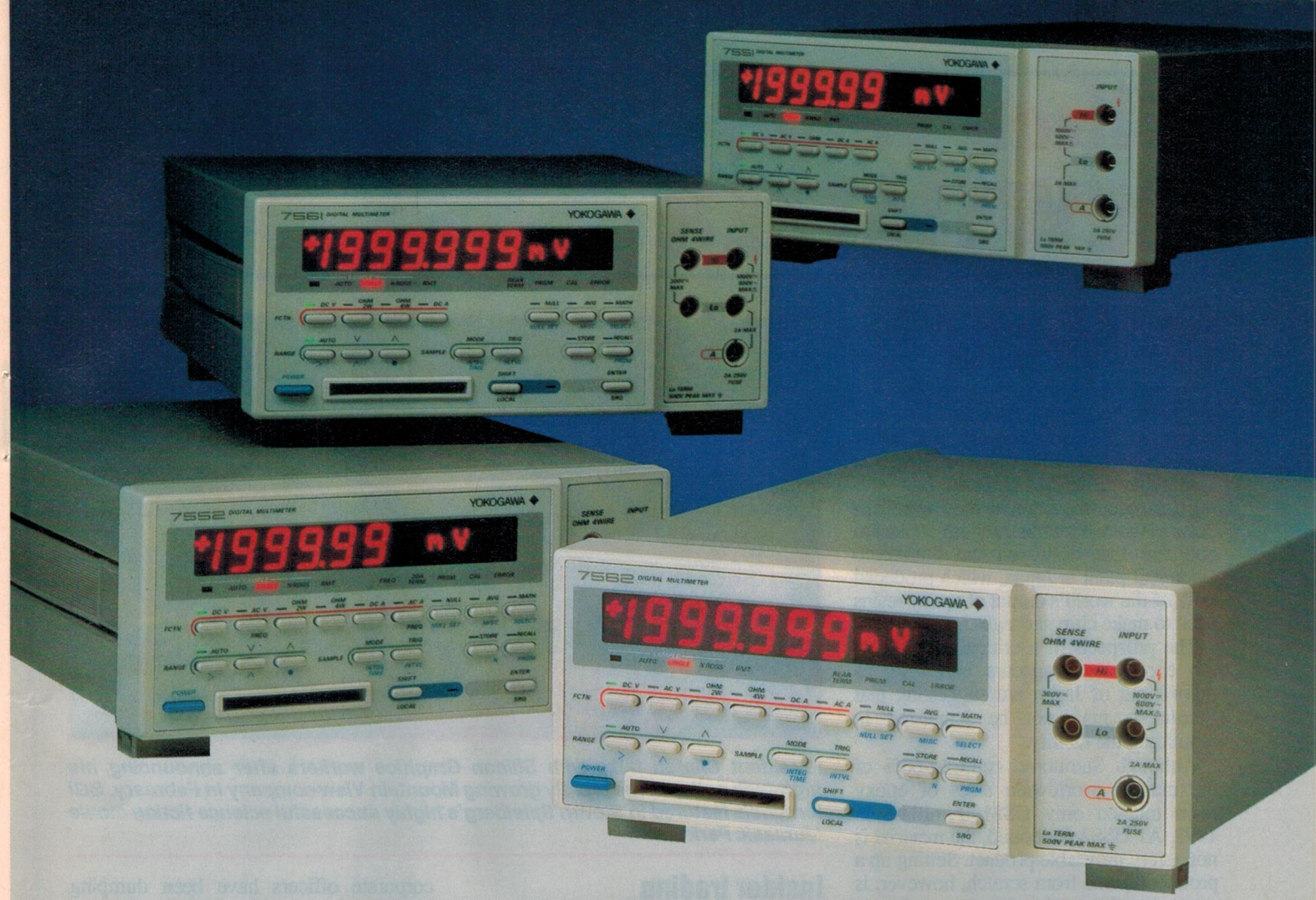
Communications monitor

Vicom Australia has released the latest in Communications Service Monitors (CSM), the COM-120A, from IFR Systems of Wichita USA. The COM-120A is a microprocessor controlled, digitally synthesised CSM. Its main functions include an RF generator, full duplex operation, audio/data/signalling generators, DVM, spectrum analyser, RF receiver and oscilloscope. Also included are a distortion, audio frequency, RF power, received level, deviation, SINAD, frequency error and modulation meters.

This instrument has a flat panel display which shows all the options and functions used. For example, when in receive mode on the screen there are a number of activities displayed; RF power and frequency, modulated AF frequency and distortion meters; plus the spectrum analyser or oscilloscope. Many of these functions are performed simultaneously.

The COM-120A is a portable unit with an internal rechargeable battery. There are a number of options available such as a variable function generator, internal generate amplifier, SSB receiver filter, audio digital signalling, tracking generator and IEEE 488 interface. An aluminium transit case, made in Australia, is available with the unit.

For more information circle 205 on the reader service coupon or contact Vicom Australia, 4 Meaden Street, South Melbourne 3205; phone (03) 690 9399. ❖



True 6 1/2 digit, high accuracy (0.003%) plus high speed sampling (333/s) – for $1690!*

The 7562,one of a line of desk-top multimeters, features Yokogawa's original feedback pulse width modulation method which gives excellent stability, high noise immunity and linearity.

- ***True 6 1/2 digit resolution without reduced dynamic range typical of some DMMs***
- ***6 1/2 digit accuracy ±0.003% +15dig (90days)***
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- ***Large 1000 measurement memory capacity (up to 8000 using optional IC memory card)***
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Check the 7550/7560 range

Model	7551	7552	7561	7562
Display digits	5 1/2		6 1/2	
Samples/second	125		333	
Vdc Accuracy	0.005%		0.003%	
Vac Accuracy	0.3%		-	0.15%
AC/DC Current	2A	20A	2A(dc)	2A
Ohms	200MΩ		200MΩ	
Frequency	–	•	–	–
Relative Measurements	•	•	•	•
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Silicon Valley NEWSLETTER

Panic buying sends DRAM prices soaring

Fear of a worldwide shortage of a critical chip packaging material has sent prices of DRAM memory and other popular high-volume chips soaring. On spot markets, DRAM chips are now selling for twice the amount they were just prior to the mysterious July 4th explosion and fire that destroyed the Sumitomo Chemical plant in Japan, which produced 60% of the world's output of epoxy resins used to make chip packages.

The prospects of a critical shortage of the epoxy resin appears imminent, as reports out of Japan are suggesting that Sumitomo may not be interested in rebuilding the facility.

Although Sumitomo controls 60% of the market, worldwide sales of epoxy resin totalled only US$100 million in 1992. AT US$2 per pound, the material is not a very profitable product. Setting up a production line from scratch, however, is expensive due to the stringent purity requirement put on by chip manufacturers.

According to Bill Reed, president of the US Semiconductor Equipment & Materials Institute, reports coming out of Japan suggest that Sumitomo is negotiating instead to licence its process technology to several companies, including Dow Chemical in the United States.

Dow, ironically, recently left the epoxy resin market. But the company is reportedly studying plans to come back in, particularly with the prospect of losing Sumitomo as the dominant competitor.

Sumitomo officials in New York, like their counterparts in Tokyo, were unwilling to discuss the epoxy resin situation. They only said their company has asked a Japanese competitor to help out producing the material until the company has brought its production back on line.

Meanwhile, chip buyers are taking few chances. While major computer vendors are protected by long-term supply contracts, smaller chip users have started panic buying of certain chips, particularly DRAMs.

At chip retail outlets in Silicon Valley, 4Mb DRAMs which sold for $36 a week before, were fetching offers of more than $80 per chip.

President Clinton talks with Silicon Graphics workers after announcing his high-tech policy at the rapidly growing Mountain View company in February. SGI terminals featured in Steven Spielberg's highly successful science fiction movie 'Jurassic Park'.

Insider trading scandal rocks Apple

Apple Computer has been rocked by a major insider trading scandal, as Apple Chairman John Sculley, president Michael Spindler, and other top Apple officials were named in five class-action lawsuits in which they are accused of insider trading practices. All of the accused have declined to comment. In recent weeks, Apple's stock has plunged from more than US$90 to less than $26.

The lawsuits were filed by a lawfirm in San Diego, on behalf of all people who have purchased Apple shares between October 14 1992 and July 15 1993. According to the lawsuit, Apple executives during this period deliberately issued false and misleading statements about sales and profit margins on the sale of Macintosh products and advance demand for handheld Newton systems.

These statements, the suits claim, drove up Apple stock prices on Wall Street. The artificial surge in stock prices was used by the Apple executives to sell more than 440,000 shares of their own stock at huge profits, as most of the shares were acquired through stock options at prices as low as US$6 a share.

Financial data has shown that 18 Apple corporate officers have been dumping their stock in the company during the past 18 months. In all, the 18 officers have sold some US$25 million worth of their Apple stock without ever buying a single share back. Among others:

- John Sculley sold 150,000 shares at an average US$61.75 per share. Most of the shares Sculley purchased through stock options at less than $7 per share.
- Michael Spindler sold 94,000 shares for US$53.85 per share after paying less than $29 per share through exercising his options on the shares.
- Former Apple chairman A.C. Markkula, now a director, sold US$7.5 million worth of his Apple stock at an average $60 per share.

All of the executives' stock sell orders occurred before the company announced a series of disappointing results, including a huge loss for the just ended quarter.

Among other things, Apple executives said Macintosh models weren't selling as quickly as expected or at volumes sufficient to offset low profit margins. They also disclosed that the Newton had run into delays.

"In fact Macs were not selling at all. They were not gaining market share with the old Mac models and new machines such as the Newton. They were just sitting

there and getting killed, and they didn't let anybody know until April," said Patrick Coughlin, an attorney for the plaintiffs.

US disappointed in Tokyo accord

Three major US high-tech trade organisations reacted with disappointment to the failure of the leaders of the seven leading industrial nations to eliminate tariffs on electronics products.

While negotiators in Tokyo agreed on the elimination of tariffs on a broad range of manufactured goods, semiconductors and other high-tech products were left off the list — to the disappointment of the Semiconductor Industry Association, the American Electronics Association, and the Computer & Business Equipment Manufacturers Association.

AEA president Richard Iverson said "It is imperative to the health of the broad US electronics and information technology industries that tariffs on their products be eliminated throughout the world's major market."

While conceding their failure to include high-tech goods in the tariff elimination proposal, trade ministers for the seven participants in Tokyo vowed they would continue to negotiate to achieve similar drastic tariff reductions in the high-tech area.

Together the SIA, AEA and CBEMA represent more than 3000 US electronics firms, employing over 2.3 million people and accounting for US$320 billion in annual business.

The major obstacle in removing tariffs on semiconductors and other high-tech products worldwide has been the European Community, which has refused to negotiate on the elimination of its 14% tariff on semiconductors and 4.9% tariff on computer parts. The US, Canada and Japan have eliminated all such tariffs.

Flat panel industry gets a boost

The establishment of a major US presence in the flat panel display market has received a huge boost, as the Pentagon's Advanced Research Projects Agency (DARPA) announced it is investing US$20 million in a newly formed US flat panel display consortium. The United States Display Consortium (USDC) will have 10 initial members, including Zerox, Motorola and AT&T.

The formation of the USDC was announced at the start of the annual Semicon West Trade show in San Francisco. As part of the USDC formation, the Semiconductor Equipment & Materials Institute (SEMI) also announced it had formed a new division known as the SEMI North American Flat Panel Display Division.

The SEMI Group will consist of Semi members with interests in designing and producing production equipment and materials for the flat panel display industry.

Besides playing the role of matchmaker between USDC members working on flat panel display projects and SEMI equipment vendors, the group will also work with the USDC to set standards for equipment, materials, quality benchmarking, and yield improvement.

Peter Mills, president of the USDC said SEMI's involvement is key to the success of the US flat panel display industry. "We felt it was essential to involve the suppliers in the USDC from the beginning. Cooperation between flat panel manufacturers and their suppliers will be required to build a US display manufacturing infrastructure in a timely fashion."

Added SEMI president Bill Reed: "This is the first stake in the ground to building the foundation of the next substantial market for our membership companies. Because there are so many similarities between the production of semiconductors and flat panel displays, SEMI is well positioned to provide the technical expertise, standards support, and educational services that will be needed to ensure USDC meets its goal of building a competitive US flat panel display industry."

Apple restructures, cuts 2500 workers

Apple Computer has announced that it would lay off some 2500 employees, representing 16% of its workforce, including several top executives. It will also eliminate or combine several divisions, as part of a major restructuring aimed at maintaining the company's profit margins amidst a gruesome price war in the PC market. The announcement has been expected since Apple appointed Michael Spindler to replace John Sculley as president and CEO.

Apple said that as part of the restructuring, the company will take a one time charge against profits in the current quarter to cover the cost of severance payments and the closing of several divisions. Analysts expect the charge to be around US$250 million. Such a charge would cause Apple to report a steep loss for the current quarter.

Apple said it would freeze the salaries of all its employees and cut the pay of executives (vice presidents and up) by 5%, effective July 3.

The restructuring program is the largest in Apple's history. In 1991 Apple laid off 1500 workers. One of the departments that is expected to be hit hard with the lay-offs will be engineering. Apple employs between 3000 and 4000 engineers. "You have to be wondering what all those engineers are doing over there, considering the number of new products we produce," said one high-level Apple executive.

"This is a broad re-engineering of the company, and we are looking at all aspects of the business," said a spokeswoman for Spindler.

Opposition to Cablesoft Venture

Opposition is mounting in Washington DC and among the US computer and television industries to the planned formation of Cablesoft, a joint venture between Microsoft and the two largest cable TV networks in the US.

Plans for the formation of Cablesoft were announced by Bill Gates at the Digital World Expo in Beverly Hills. The aim of the company would be to develop the operating system that would allow televisions to be controlled and function much like today's graphics based user interfaces on computer displays.

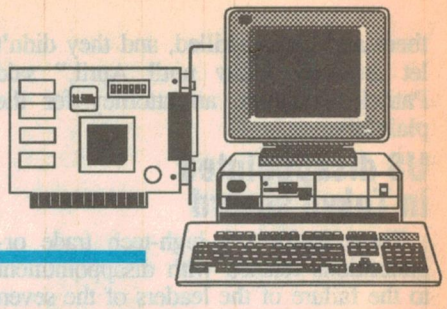
Industry and government officials have begun to voice concerns that the proposed Cablesoft venture would be strong enough to set an industry standard for the interactive television of the future. The adoption of a closed standard would have major implications as it would enable the Cablesoft partners to reap in huge sums in royalties and licensing from other cable operators. It would also stymie competition and threaten to lock non-mainstream programmers from offering innovative services on the networks controlled by Cablesoft.

Edward Markey, chairman of the House Subcommittee on Telecommunications & Finance, urged the Federal Communications Commission to ensure that the future television industry will remain as open and accessible as possible. Markey warned Cablesoft is "a new force in the marketplace which could have the clout necessary to create a single, closed standard for television and software."

Earlier, at Digital World, Lotus founder Mitch Kapor had warned that Cablesoft frightens him as the venture could keep outsiders off the interactive cable system.

At Kaleida, the joint IBM/Apple multimedia software venture, president Nat Goldhaber predicted that 'Bill Gates would use every ounce of his skill to dominate that world (TV), the way he dominates the personal computer world.' ❖

Computer News and New Products

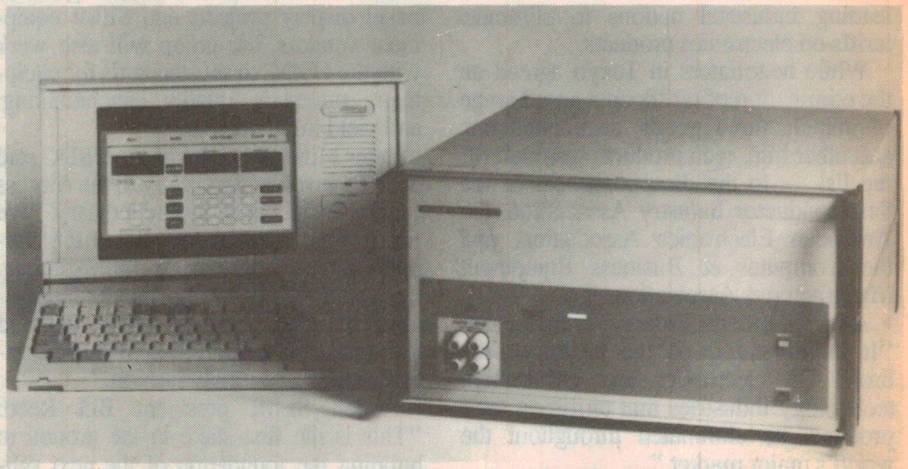


Calibration workstation

Philips has released the Fluke 5130A Calibration Workstation, a new easy to use calibration solution designed to help cost conscious companies meet emerging quality standards such as ISO 9000.

The system is an economical, one stop calibration tool. Calibration and documentation are controlled and managed from a central PC, resulting in a system that is easily operated with a minimum of training or technical experience.

Fluke's 5130A Calibration Workstation integrates PC software, for managing and documenting the calibration process, with analog hardware that maintains traceability to recognised standards.



The system offers the capability to calibrate analog and digital multimeters up to 4-1/2 digits, and related instruments. The system supports ISO 9000 requirements for documented and controlled calibration procedures and processes, including reporting of forward and reverse traceability, adequacy and equipment location.

The 5130A includes a five function calibrator, front panel control software for easy manual operation, IEEE-488 interface card, cables, instruction manuals, over 90 procedures and 90 report formats.

It provides traceability to national standards for alternating and direct voltage, alternating and direct current and resistance.

For further information circle 161 on the reader service coupon or contact Philips Test & Measurement, 34 Waterloo Road, North Ryde 2113; phone (02) 888 8222.

LaserMaster colour printer

LaserMaster has released its CrayonFX Colour Printer, offering full colour thermal wax printing.

The CrayonFX Colour Printer is a reliable, multi-platform compatible unit, which comes complete with Apple's ColorSync software for 'behind-the-scenes' colour management. ColorSync can match colours from scanned images so that documents have the right colours the first time they are printed.

CrayonFX comes with direct driver software for both Mac QuickDraw and Microsoft Windows operating systems. These provide fast colour printing, and can be connected to Apple and IBM compatible systems at the same time. Networking is no problem either, because the CrayonFX can be used via Apple Talk and Windows for Workgroups.

The printer comes complete with 50 TrueType fonts, which are fully compatible with any existing Type 1 fonts. It is priced at $3295 (ex tax), including all software and accessories.

For further information circle 168 on the reader service coupon or contact Mitsui Computers, 632 Burwood Road, Hawthorn East 3128; phone (03) 882 8866, fax 882 7073.

Up to date SPICE models

Intusoft has announced that it will offer SPICE models on floppy disk, in conjunction with its SPICE newletter. The new subscription service includes delivery of a floppy disk with each *Intusoft Newletter* (4 - 6 times per year). This is a very valuable service since most SPICE software vendors do not sell SPICE models separately from their simulators, and SPICE model library updates are not always frequent enough to satisfy users.

In the first four newsletter floppies this year (Jan - July), Intusoft has already distributed over 1000 models for a variety of components including digital ICs using the IBIS format, op-amps from eight different vendors, and discrete parts like IGBTs, BJTs, JFETs and SCRs. Past issues have contained models for PWMs, power MOSFETs, dual-gate MOSFETs,

Video frame grabber

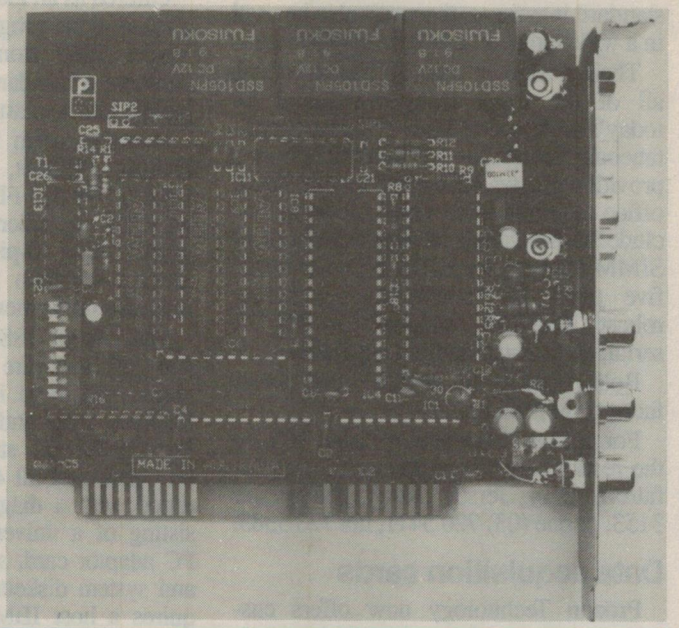
The Mondotronic MF500B monochrome video frame grabber is fully designed, manufactured and supported in Australia. It is a low cost, plug in card for the PC/AT and compatibles. Included in the design are features which enable the MF500B to be used from a simple domestic video capture, to professional digital video storage and transmission, or a complete video security system with PLD applications.

Up to three video inputs are accepted, from any standard video source such as a video camera, camcorder, VCR or video disk player. It features eight user selectable grab resolutions from 128 x 100 to 320 x 256 pixels. Frames or fields are captured in real time of 20ms, with automatic black/white level control in six or eight bit mode, with software controlled brightness and automatic image enhancement.

Images are captured and displayed on the VGA or SVGA screen in continuous mode and are frozen remotely, or at the push of the space bar. When saved in compressed format, only 7-30KB of disk space is used. Captured images can be edited, dithered and printed on laser or dot-matrix printers. Drivers are included to grab and save images at user selectable time intervals while the computer is used for other purpose or left unattended. These images can be date/time stamped, and bar-coding can be added to images for ID card production.

The MF500 is priced from $390, including sales tax.

For further information circle 167 on the reader service coupon or contact Mondotronic, PO Box 296, Glen Waverley 3150; phone (03) 802 4110, fax 803 0376.



fuses, lasers, and switched capacitor filters, to name a few.

The *Intusoft Newsletter* contains application notes on simulating with SPICE, and frequently includes articles on SPICE modelling and solving convergence problems. A regulator column in the newsletter, 'The Intusoft Modelling Corner' keeps an up to date track of all the parts modelled by various hardware manufacturers, including all of the vendor supplied op-amp models. Any new models provided by manufacturers are checked out and then included on the accompanying floppy disk to subscribers. The models can generally be used directly with any Berkeley SPICE compatible simulator and both Macintosh and PC formats are supported.

For further information circle 173 on the reader service coupon or contact ME Technologies, PO Box 50, Dyers Crossing 2429; phone (065) 50 2254.

Australian made printer/sharer

Released at CeBit'93 in Germany, the ASeries A2000 and A2100 are the latest high performance, low cost Printer Sharing Devices (PSD), designed and manufactured by Alfatron.

These devices connect up to eight PCs and printers in any combination, and boast a measured throughput of 42,000 characters per second.

They are further enhanced by 'easy to use' setup and control software for both the WINDOWS and DOS GUI environ-

ments. Because these devices use industry standard interfaces, they may also be used in a wide range of industrial applications.

Their design is new and incorporates all of the latest features required by today's high speed laser printers. Simultaneous throughput for multiple printers provides greater efficiency for the small office environment. Other features include bi-directional parallel ports; use of SIMM memory for buffering up to 4MB; five types of handshaking, including robust Xon/Xoff, support for RS-422 serial; and string handling capability.

Both products are designed and manufactured in Melbourne.

For further information circle 163 on the reader service coupon or contact Alfatron, 5/14 Jersey Road, Bayswater 3153; phone (03) 720 5411, fax 720 5383.

Data acquisition cards

Procon Technology now offers customers a range of data acquisition cards for the IBM PC.

A low cost 12-bit ADC/DAC card provides 16 channels of analog input and one channel analog output, with voltage ranges of 0 to 9V, or -9 to +9V. The conversion time of the ADC is 60us.

The Super 12-bit ADC/DAC card provides 16 channels of single ended inputs, or eight differential inputs and one analog output (a second is optional). Voltage ranges are 0 to 2.5V, 0 to 5V, 0 to 10V, -2.5 to +2.5V, -5 to +5V, and -10 to +10V. These are user selectable. The conversion time of the ADC is 28us.

Each card comes with a connecting cable, manual and a software diskette with example programs in BASIC, C, Pascal and assembler.

Also provided on the diskette is a data acquisition program. This allows data to be captured, and displayed graphically on the computer's screen, or stored to disk for review or for later processing by user-written programs. The low cost card is currently available at $175 (ex tax), and the Super 12-bit card is $290 (ex tax).

For further information circle 165 on the reader service coupon or contact Procon Technology, PO Box 655, Mt Waverley 3149; phone (03) 807 5660, fax 807 8220.

PC-based EPROM programmer

Offered as an inexpensive alternative to a stand alone programmer, the PC-based Model 1880 from Minato Electronics converts a standard PC/XT/AT or compatible into a smart EPROM programmer.

It can program 1200 device types, including PROMs, E/EEPROMs, PALs, GALs, FPLAs, FPLSs, PEELs, FPLDs, MACHs and microcontrollers, all up to 16MB, via a 40-pin standard ZIF socket. Device selection by device name and manufacture is menu driven.

The Model 1880 is easy to operate, with all software controlled from the menu, and there is a full screen editor for fuse map and memory buffer editing. A JEDEC standard vector test is provided, and all 40-pin drivers are self tested with a diagnostic program. Consisting of a universal programmer unit, PC adaptor card, system interface cable, and system diskette, the model 1800 requires a host IBM PC/XT/AT or compatible with at least 512KB RAM. The system supports surface mount devices with optional adaptors.

For further information please circle contact 170 on the reader service coupon or contact Anitech, 52/2 Railway Parade, Lidcombe 2141; phone (02) 749 1244.

SigmaPlot for Windows

Jandel Scientific has released a Windows version of its technical graphing package, SigmaPlot. By using Windows' Graphical User Interface (GUI), it makes 2D and 3D graph creation and editing much more intuitive.

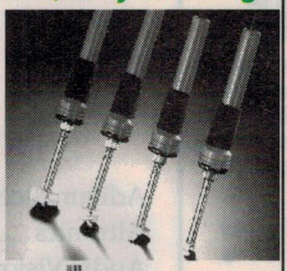
New features in SigmaPlot include plotting options, with the ability to create a gallery of graph styles that can be used as templates when creating graphs; you can import SigmaPlot DOS and Mac files in their entirety; and the data worksheet within SigmaPlot has been made more functional — blocks, rows and columns can be inserted or deleted, and specific ranges can be selected for plotting.

The new toolbox speeds up the creation and selection of text and objects, drawing, legend creation, layering, etc. The new page design summary allows you to change page background colour, select page orientation, and hide and show graphs on the page. Use the multi-level zoom feature for resizing graph on screen. SigmaPlot for Windows requires Windows 3.1, a minimum of a 386 with 4MB RAM and 5MB free hard disk space.

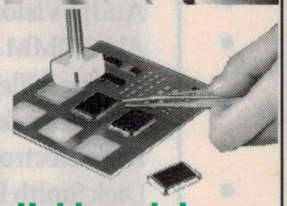
For further information circle 171 on the reader service coupon or contact Interworld Electronics & Computer Industries, 1000 Glenhuntly Road, Caulfield South 3162; phone (03) 563 5011, fax 563 5033. ❖

Looking for Precision & Quality Soldering?

Hakko 924 Desoldering Tool for Flat Packages!



The Hakko 924 has been specially produced for desoldering surface mount flat packages. It's just what professionals have been looking for! The ceramic heater element provides extremely fast heat transmission with excellent insulation – over 100MΩ when in operation. Choice of tip sizes from 12.5x12.5 to 20x20mm plus DIL up to 18mm long. **$99.95**
Replacement Tips from **$22.75**
Adaptor for 926 Iron below to take 924 tips **$22.75**



Hakko 926 Soldering Station

The Hakko 926 is a super-quick heat-up (3 sec cycle) and fast recovery iron offering high quality soldering at lower tip temperatures. The built-in ceramic heater maintains temperature to within 0.5°C of the setting. Yes this is an ADJUSTABLE temperature iron covering the range from 200°C to 480°C using a full wave zero-crossing switching system. Meets MIL-STD-2000 and operates at safe 24V.
Also available in ESD for antistatic environments. We stock a wide range of tips to suit. Ask for listing. **$183.95**

New Bulkhead Box

Handy black ABS box measuring 87x67x30mm externally. Internal mounting points for pcb upto 80x60mm approx. 11mm hole in long side for cable entry (does not trap cable). Baseplate is recessed into case for easy sealing. Moulded-in mounting brackets.
Ideal for car alarms and small outdoor projects etc. **$2.70**

GPS-3030 30V,3A Power Supply

Economical compact laboratory DC power supply with 0-30V output at up to 3A which can be floated either side of earth. Fine and coarse voltage control for accurate setting. Analog meters show voltage and current. Full overload and short circuit protection. Low ripple (0.5mV typ) and 0.2% regulation. 12 month warranty. Excellent value **$342.55**

Hakko-wick Desoldering Aid

Extra thirsty pure copper braid with lower mass for faster heat transfer. Special flux too! Ideal fr use with low wattage irons **$2.90**

DIC SC-7000 DeSoldering Tool ESD* Protected

- Now with 100W ceramic heater
- Sensor feedback digital temperature control
- * Special antistatic housing and zero crossover switching to protect sensitive components
- Suction/Hot air blow switch – suck for desoldering, blow for SMD removal

- Work on up to 12 layer boards
- Optional surface mount kit

$458 ex tax
$549.60 inc tax

NEW Parallel Data Cable

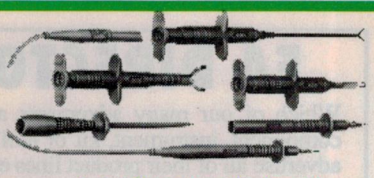
What's the easiest way to transfer data between two PC's?
With our new CC21 cable!
Simply connect the two printer ports and, using the latest version of DOS, you're away. What could be simpler? **Cable CC-21** 25pin male DB25 to 25pin male connectors. 1.8m long approx and only **$19.95**

TCM3105NL Modem Chip

see E.A. Jan 93

Single chip 1200baud FSK modem using a single 5V supply. Full and half duplex operation. On-chip group delay equalization and TX/RX filtering. Carrier detect level adjustment and carrier fail output. Reliable CMOS 16pin DIL **$16.10**

Silicone Test Leads & Accessories



Sick of those stiff plastic test leads that come with most multimeters? You know the ones that kink and produce pungent smoke when you touch them with a hot soldering iron? Well chuck them out and look at our super quality HCK Silicone Rubber leads. You wouldn't believe that a 1000V/16A cable could be so flexible. And they're soldering iron proof to 300°C.
So give your test instruments a new lease of life.
We stock one of the largest ranges available.

Cable

HCK-7062-1/5M	0.25mm Silivolt Cable	$10.95
HCK-7062-2/5M	0.25mm Silivolt Cable	$10.95
HCK-7062-1/100M	0.25mm Silivolt Cable	$141.25
HCK-7062-2/100M	0.25mm Silivolt Cable	$141.25
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HCK-7066-2/5M	0.75mm Silivolt 5m	$21.85
HCK-7066-1/100M	0.75mm Silivolt 100m	$360.85
HCK-7066-2/100M	0.75mm Silivolt 100m	$360.85
HCK-7008-1/100M	1.00mm Flexivolt Cable	$121.00
HCK-7008-2/100M	1.00mm Flexivolt Cable	$121.00

2mm Test Leads

HCK-MS101	2mm Blk 1.0m Lead	$10.20
HCK-MS102	2mm Red 1.0m Lead	$10.20

2mm Test Fittings

HCK-8234-1	2mm Blk Hook Grip	$4.20
HCK-82342-2	2mm Red Hook Grip	$4.20
HCK-9217-1	2mm Blk Stackable Plug	$1.60
HCK-9217-2	2mm Red Stackable Plug	$1.60
HCK-9225-1	2mm Blk Test Prod	$3.25
HCK-9225-2	2mm Red Test Prod	$3.25
HCK-9229-1	2mm Blk Test Tweezers	$14.05
HCK-9229-2	2mm Red Test Tweezers	$14.05

4mm Test Leads

HCK-9014-1	4mm Blk Stght 1.0m Lead	$12.95
HCK-9014-2	4mm Red Stght 1.0m Lead	$12.95
HCK-9014-3	4mm Blu Stght 1.0m Lead	$12.95
HCK-9014-4	4mm Yel Stght 1.0m Lead	$12.95
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HCK-9024-2	4mm Red Stght 1.0m Lead	$14.20
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HCK-S054	4mmYel 16A 0.5m Lead	$9.80
HCK-S055	4mm Grn 16A 0.5m Lead	$9.80
HCK-S056	4mm Vio 16A 0.5m Lead	$9.80
HCK-S101	4mm Blk 16A 1.0m Lead	$10.60
HCK-S102	4mm Red 16A 1.0m Lead	$11.80

4mm Test Leads (cont)

HCK-S103	4mm Blu 16A 1 .OU Lead	$11.80
HCK-S104	4mm Yel 16A 1.0m Lead	$11.80
HCK-S105	4mm Grn 16A 1.0m Lead	$11.80
HCK-S106	4mm Vio 16A 1.0mLead	$11.80
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HCK-S202	4mm Red 16A 2.0m Lead	$15.80
HCK-S203	4mm Blu 16A 2.0m Lead	$15.80
HCK-S204	4mm Yel 16A 2.0m Lead	$15.80
HCK-S205	4mm Grn 16A 2.0m Lead	$15.80
HCK-S206	4mm Vio16A 2.0m Lead	$15.80
HCK-S151	4mm Blk 16A 1.5m Lead	$13.75
HCK-S152	4mm Red 16A 1.5m Lead	$13.75
HCK-S153	4mm Blu 16A 1.5m Lead	$13.75
HCK-S154	4mm Yel 16A 1.5m Lead	$13.75
HCK-S155	4mm Grn 16A 1.5m Lead	$13.75
HCK-S156	4mm Vio 16A 1.5m Lead	$13.75

2mm to 4mm Adaptors

HCK-9227-1	4mm/2mm Blk Adaptor	$2.65
HCK-9227-2	4mm/2mm Red Adaptor	$2.65

4mm Test Fittings

HCK-9120-1	4mm Blk Clamp Grip 50mm	$14.30
HCK-9120-2	4mm Red Clamp Grip 50mm	$14.30
HCK-9123-1	4mm Blk Coupling XHK	$2.20
HCK-9123-2	4mm Red Coupling XHK	$2.20
HCK-9295-1	4mm Blk Crocodile 34A	$5.05
HCK-9295-2	4mm Red Crocodile 34A	$5.05
HCK-9209-1	4mm Blk Crocodile 2A	$2.80
HCK-9209-2	4mm Red Crocodile 2A	$2.80
HCK-9206-1	4mm Blk Hexagonal Probe	$3.60
HCK-9206-2	4mm Red Hexagonal Probe	$3.60
HCK-9112-1	4mm High Voltage Prod	$4.95
HCK-9112-2	4mm Red High Volt Prod	$4.95
HCK-9113-1	4mm Blk High Volt Prod	$5.55
HCK-9113-2	4mm Red High Volt Prod	$5.55
HCK-9116-1	4mm Blk Hook Grip	$12.85
HCK-9116-2	4mm Red Hook Grip	$12.85
HCK-9119-1	4mm Blk Jaw Grip	$19.95
HCK-9119-2	4mm Red Jaw Grip	$19.95
HCK-9124-1	4mm Blk Adaptor XSA	$4.45
HCK-9124-2	4mm Red Adaptor XSA	$4.45
HCK-9214-1	4mm Blk Panel Mount Socket	$4.35
HCK-9214-2	4mm Red Panel Mount Socket	$4.35
HCK-9132-1	4mm Blk Panel Twin Socket	$4.70
HCK-9132-2	4mm Red Panel Twin Socket	$4.70
HCK-9205-1	4mm Blk Square Probe	$3.20
HCK-9205-2	4mm Red SquareProbe	$3.20
HCK-9203-1	4mm Blk Stackable Phg	$3.25
HCK-9203-2	4mm Red Stackable Plug	$3.25
HCK-9230-1	4mm Blk Test Tweezers	$13.70
HCK-9230-2	4mm Red Test Tweezers	$13.70

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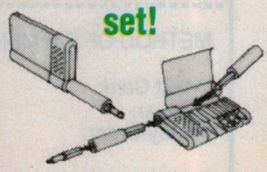
- ***Extra tough for industrial users***
- ***High energy fuse and PTC protection against overloading***
- ***O-ring sealed case, switch and jacks against dirt and moisture***
- ***Protective holster and tilt stand with lead storage***
- ***Test probes have finger shields and sleeved plugs***
- ***Thick walled ABS case and shock mounted LCD withstands 2m drop on to concrete floor***
- ***Unique rotary switch with berylium copper contacts and gold plated pcb***

Model 103 & 105
- 4000 count
- Data hold & Relative functions
- 0.1% (105) or 0.5% (103) dc accuracy
- 8 functions inc frequency and capacitance

Appa 88	$ 94.80*
Appa 93	$142.80*
Appa 96	$166.80*
Appa 98	$214.80*
Appa 103	$298.80*
Appa 105	$358.80*
Appa 76 Component Tester	$142.80*
Appa 35 Clamp Meter	$142.80*

** Call for Tax-Free prices*

No technician should be without this Screwdriver set!



German quality and ideal for toolbox, glovebox or pocket. Includes universal magnetic holder for use with power drills, 5.5x0.8 and 6.5x1.2 flat, Philips No 1 and2 and Pozidrive No1 and 2 bits.
The great thing is that the case acts as a handle for the bits, so it's self contained in a space of only 70x50x15mm **$20.50**

8.30am to 5.00pm Mon to Fri. 8.00am to 12 noon Saturday.
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All prices include Sales tax unless stated otherwise.
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READER INFO NO. 32

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Which of our many advertisers are most likely to be able to sell you that special component, instrument, kit or tool? It's not always easy to decide, because they can't advertise all of their product lines each month. Also some are wholesalers and don't sell to the public. The table below is published as a special service to EA readers, as a guide to the main products sold by our retail advertisers. For address information see the advertisements in this or other recent issues.

Supplier	State	A	B	C	D	E	F	G
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Dick Smith Electronics	ALL	●	●	●	●	●	●	●
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KEY TO CODING:

A Kits and modules
B Tools
C PC boards and supplies
D Components
E IC chips and semiconductors
F Test and measuring instruments
G Reference books

Note that the above list is based on our understanding of the products sold by the firms concerned. If there are any errors or omissions, please let us know.

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PROJECT QUERIES: Advice on projects is limited to postal correspondence only and to projects less than five years old. Price $7.50. Please note that we cannot undertake special research or advise on project modifications.

Members of our technical staff are not available to discuss technical problems by telephone.

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PAYMENT: Must be negotiable in Australia and payable to 'Electronics Australia'. Send cheque, money order or credit card number (American Express, Bankcard, Mastercard or Visa card), name and address (see form).

ADDRESS: Send all correspondence to: The Secretary, Electronics Australia, P.O. Box 199, Alexandria, NSW 2015; phone (02) 353 0620.

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ADVERTISING INDEX

This index is provided as an additional service. The publisher does not assume any liability for errors or omissions.

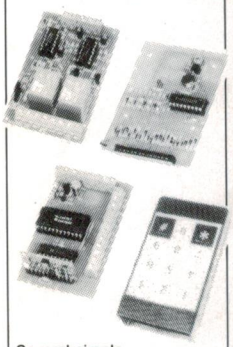
MINI EL-CHEAPO LASER KIT

The smallest and most efficient tube — inverter kit combination we ever offered. The used laboratory quality 1mW tube is 155mm long and has a diameter of 25mm, and the power supply would occupy a similar volume. The switched mode supply is very efficient! Draws approximately 600mA from a 12V battery, and it could be easily modified for operation from lower and higher DC voltages. A very compact combination that produces a very bright and low divergence beam. Great for portable use. Incredible pricing:

$69

for the tube, the inverter kit and the instructions.

12 CHANNEL UHF REMOTE CONTROL



Several simple modifications to this project (E.A. Mar. 93) greatly improve it's performance and increase it's range to over 300 metres! **Previous purchasers should contact us.**

This system is provided in kit form and features a 12 channel keypad operated and SAW resonator locked transmitter, a 12 channel receiver that is supplied with a pre-assembled "Front-end" UHF receiver module and a two channel relay driver PCB which can be used in multiples. All the PCB's are solder masked and silk screened and the transmitter fits into a hand held commercial case which has a battery compartment: Very professional!

These SPECIAL reduced prices apply for two months only:

TRANSMITTER KIT
$30
TRANSMITTER CASE
$10
RECEIVER KIT
$40
RELAY DRIVER KIT
$20

SUPER MAGNETS

These small cylindrical Neodymum Iron Boron magnets have a diameter of 10mm and are 3mm thick. However they are much, much stronger than conventional magnets. You will not be able to separate two of these by pulling them directly away from each other!

$4.50 ea.

TV TUNERS

These famous brand TV tuners were intended to convert some colour computer monitors to COLOUR TV recievers: The monitors that have a composite video input, not the RGB types. They contain all of the ncessary signal processing and channel switching: Antenna IN, to Composite video and line level audio output. They are a commercial product which is completely enclosed and mains powered. The channel is selectable by 12 illuminated pushbutton switches and seperate preset adjustments allow each of the pushbutton to access any channel in the VHF-UHF range. Supplied with a "rabbit ears" antenna. A circuit for the unit is provided. We should have more information and circuits, showing how to convert the composite video output to an RGB output, convert this unit to a Stereo TV tuner. LIMITED SUPPLY.

$139

LASER POINTER

When this magazine goes to print we will have in stock a very small 5mW-670nM laser diode based pointer. This pointer actually uses a 5mW laser diode: Very bright! Do not be misled by advertisements that advertise pointers with a power output of 5mW maximum, as these could have a power output of as little as 1mW. The SPECIAL introductory price for our pointer is an all time low:

$139

IR VIEWER "TANK SET"

ON SPECIAL is a set of components that can be used to make a complete first generation Infra Red night viewer. These matching lenses tubes and eyepieces were removed from working tank viewers, and we also supply a suitable EHT power supply for the particular tube supplied. This power supply may be ready made or in kit form: Basic instructions provided. The resultant viewer requires IR illumination.

$150-$200

SOLAR CHARGER

Use it to charge and or maintain batteries on BOATS, for solar LIGHTING, solar powered ELECTRIC FENCES etc. Make your own 12V-4WATT solar panel. We provide four 6V — 1 WATT solar panels with terminating clips, and a PCB and components kit for a 12V battery charging regulator and a three LED charging indicator: See March 93 S.C. Incredible value!

$42

6.5 Ahr. PANASONIC gel battery $35, ELECTRIC FENCE PCB and all onboard components kit $40: See S.C. April 93.

PAGER

Within 4 weeks we will have available a kit for a Pager with a 300 metre range. The transmitter will have provision for two resonance microphones and a trigger input and will operate from the inside of the vehicle: Will not require the external car antenna. The receiver will fit into a hand held case with a battery compartment and consume less than 3mA from it's 9V battery. The complete kit for the transmitter and the receiver will cost approximately:

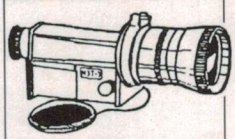
$75!!

MAGNETIC CARD READERS

New units that include a 20 character alphanumeric dot matrix display with alphanumeric capability, a keypanel with full alphanumeric entry, lithium back up battery and a flat cone speaker. These require a 7.5V DC supply. A professional product that is great for experimentation.

$50

PASSIVE NIGHT VIEWER



This is a completed commercial monocular hand held night viewer, that employs an image intensifier tube: Luminous gain of 12500! The viewer is of a USSR military standard, and will produce useful images in as little as starlight illumination. Has adjustable low light objective lens, adjustable eyepiece, and is supplied with a carry case. Limited supplies at an incredible price of:

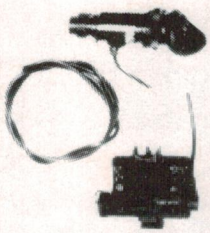
$750

9" AMBER MONITOR

These are not enclosed composit monitors that can be powered from a 12V D.C. supply.

$60

BARGAIN MONOCULAR VIEWER

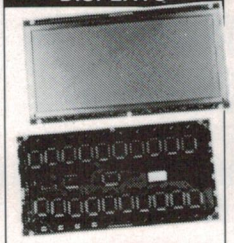


A very small but complete IR telescope which only needs an EHT power supply, which is provided in kit form: See S.C. Nov. 92. We have got a LIMITED STOCK of some units that are "Full Spec." but may need a little cleaning up. We are offering them at a greatly reduced price of:

$179

Includes the IR telescope, power supply kit (box included), and an IR filter: See S.C. Nov. 92. Alternatively, instead of the kit power supply, we can provide the original power supply for these tubes, at the same price: Specify choice of supply.

640 X 400 LCD DISPLAYS



Brand new Matsushita 640 X 400 dot displays with a 128 X 205 mm screen size. Has a fluorescent backlighting strip and comes with 15 pages of data:

$39

VOICE RECORDING MODULES

LOOK

These "State of the art" solid state voice recording modules can record and play back messages up to 20 seconds long. They are very small and produce good quality sound. The module has an inbuilt battery, its overall dimensions are 50 X 60 X 5mm and it is wired to a flat speaker which has a diameter of 40mm and is 5mm thick. The speaker also doubles up as a microphone and it has a diameter of 40mm and is 5mm thick.
Incredible product at only:

$25

12V OPERATED LASER

This combination includes one used 3mW SIEMENS visible red laser tube and one 12V Universal Laser power supply MKIII kit. The inverter is easy to construct since it is supplied with a prewound transformer, and solder masked and screened PCB.

$89

IR LASER DIODE SPECIAL

If you have never experimented with laser diodes, don't miss out on this SPECIAL. We supply a brand new 780nM LASER DIODE (Barely visible) with small plastic COLLIMATING LENS to suit, a HEATSINK for the diode, a PCB and components kit for a suitable CONTANT CURRENT DRIVER, a suitable PIN DIODE that can serve as a detector, plus some INSTRUCTIONS. Suitable for medical use, perimeter protection, data transmission, IR illumination, etc. Experimenters delight at a SPECIAL PRICE OF ONLY:

$30

UNINTERRUPTABLE POWER SUPPLY (UPS)

LIMITED STOCK!

THESE ARE VERY COMPACT, HIGH QUALITY, UPS's. They feature a 300W-450W **SINE WAVE INVERTER.** The inverter is powered by two series 12V-6.5AHr. (24V). batteries that are built into the unit. **There is only one catch:** Because these NEW units have been in storage for a while, we cannot guarantee the two batteries for any period of time, but we will guarantee that the batteries will perform in the UPS's when these are supplied. We will provide a three month warranty on the UPS's, but not the batteries. A circuit will also be provided. **PRICED AT FRACTION OF THEIR REAL VALUE: BE QUICK!**

$299

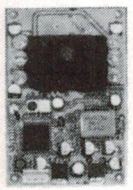
We may also have some similar 600 Watt UPS's available: Similar story. New 6.5 AHr. batteries: $35 ea. Freight charge: $15 per UPS.

UHF REMOTE CONTROL SPECIAL

On special for two months only is our latest SINGLE CHANNEL UHF REMOTE CONTROL: See SILICON CHIP Dec. 92 issue. YES this is the one that is SAW resonator locked and has a prebuilt UHF RECEIVER front end module. The SPECIAL price for one complete transmitter kit (Battery and case included), and one receiver PCB and all on-board components kit is:

$40

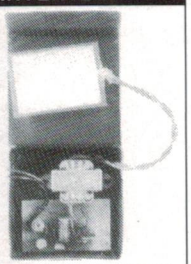
MINIATURE CCD CAMERA



A monochrome CCD Camera that is totally assembled on a small PCB and includes an Auto Iris lens: Overall dimensions of camera are 24 X 54 X 120mm. The camera can work with as little as 0.1 lux illumination, and it is IR responsive! The six IR leds that are included on the P.C.B. are useful for producing good images in a totally dark room! Available in EIA or CCIR standards.

$199

BACKLIGHTING INVERTER KIT



This kit inverter can power all the Fluorescent screens that are supplied as an option with many LCD displays. 5-12V operation with adjustable output power for different screen powers — brightness. A 60 X 45mm fluorescent screen and a plastic case will be supplied for FREE with each kit. When powered by the inverter this screen will light a brilliant white whilst the inverter only draws 100mA from the battery: Very efficient small fluorescent light! Experimenters delight at only:

$12

For the inverter kit and one screen. Additional screens $3 ea.

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A host of user-friendly features

Many special features make the Fluke DMMs and Philips ScopeMeter more convenient and easier to use.

The display screens are easy to read. Touch Hold® on the Fluke 70 and 80 series freezes the display on stable readings - so you can use both hands to take a measurement.

The Fluke 10 series features a time saving V chek™ - a Fluke innovation.

All series feature auto and manual ranging. In short, these user-friendly tools make taking measurements a great deal easier for the on site technician.

The Fluke Multimeter Series

How much meter can you get into a multimeter?

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The perfect, one-tool trouble shooting package.

The ScopeMeter is a rugged, high-performance 50 MHz digital storage oscilloscope and a full-featured 3000 count multimeter - in one, handheld instrument.

It's the ideal companion for on-the-go service and test.

THE UN-BREAKTHROUGH THAT WILL HAVE YOU SMILING FROM VOLTS TO OHMS

Fluke and Philips present the ScopeMeter. Plus a tough range of Digital Multimeters

DESIGNED WITH USER SAFETY IN MIND

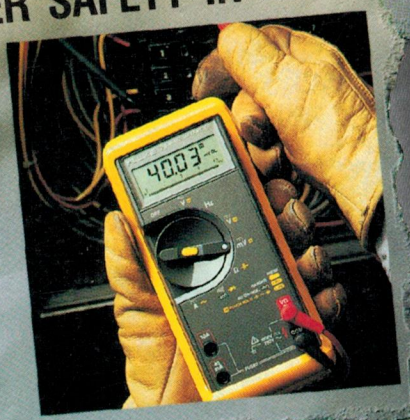
User safety is a primary consideration

A safe investment

Ask someone who owns a Fluke and Philips meter. They'll tell you that even if you accidentally overload it or hook it up wrong, you can depend on it.

Fluke and Philips meters offer excellent overload protection.

Further safety features include recessed input jacks, non-inflammable cases, test leads with shrouded connectors and finger guards.



HOW TO BEAT THE HIGH COST OF CHEAP METERS

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A tool isn't very useful if it won't withstand the hazards of everyday use.

By putting them through some of the toughest simulated accidents imaginable, Fluke and Philips meters are as tough as they are affordable.

Tough enough to work wherever you work, they offer a long battery life.

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